Los Osos System Water Master Plan

Golden State Water Company

December 2019

Executive Summary

Purpose

The purpose of this Master Plan is to assess Golden State Water Company's (GSWC) Los Osos System's ability to meet current and future water needs, and to identify upgrades needed if deficiencies exist. This assessment is developed by using hydraulic analysis criteria, future demands and available supply, water quality standards, and condition of facilities.

These updates provide GSWC with a basis to determine the impacts of new development on the existing system and to identify system deficiencies and improvements needed to correct them. These system improvement needs are used as the basis for developing the Capital Improvement Program (CIP) for the system. TABLE 9-1 summarizes the CIP projects identified in this master plan.

GSWC's goal is to meet the minimum requirements identified in the technical memorandum titled *Golden State Water Company Master Planning Criteria and Standards* (see Appendices).

Master Plan Process

This master plan document is organized as follows:

- Update existing system information
- Establish existing demands and forecast future demands
- Update system's hydraulic model
- Evaluate supply and storage capacities
- Perform hydraulic analyses and evaluation
- Identify water quality issues
- Assess condition of facilities in the system
- Develop CIP

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Acronyms and Abbreviations

1,1-DCE	1,1-dichloroethylene
2016 WMP	Los Osos 2016 Water Master Plan
AACE International	Association for the Advancement of Cost Engineering International
ADD	average day demand
AFY	acre-feet per year
amsl	above mean sea level
AOB	ammonia-oxidizing bacteria
CIP	capital improvement program
CPUC	California Public Utilities Commission
DDW	State Water Resources Control Board, Division of Drinking Water
DPB Rule	Disinfectants and Disinfection Byproducts Rule
DWR	California Department of Water Resources
EPA	U.S. Environmental Protection Agency
FCV	flow-control valve
fps	foot or feet per second
GAC	granular activated carbon
gpm	gallons per minute
GSWC	Golden State Water Company
GWO	General Work Order
HPC	heterotrophic plate count
IDSE	Initial Distribution System Evaluation
MCL	maximum contaminant level
MDD	maximum day demand
MG	million gallons
MHD	minimum hour demand
NAICS	North American Industry Classification System
NOB	nitrite-oxidizing bacteria

O&M	operations and maintenance
PCE	tetrachloroethylene
PHD	peak hour demand
PRV	pressure-regulating valve
psi	pounds per square inch
PSV	pressure-sustaining valve
SCADA	supervisory control and data acquisition
SDWA	Safe Drinking Water Act
TDS	total dissolved solids
TTHM	total trihalomethanes
VOC	volatile organic compound
WMP	Water Master Plan

SECTION 1

Introduction

1.1 Overview of Golden State Water Company

GSWC is a subsidiary of American States Water Company, an investor-owned utility dedicated to increasing value through the expert management of utility assets and services. As a public utility, GSWC is committed to the purchase, production, distribution, and sale of water to over 260,000 customer connections.

GSWC is organized into three regions throughout the state of California. Region I is located in northern and central coast of California. Region II serves communities in Los Angeles County. Region III serves communities in Los Angeles, San Bernardino, Imperial, and Orange counties.

FIGURE 1-1, provided at the end of this section, shows the locations of all GSWC water systems.

1.2 Master Plan Update

The purpose of this master plan is to assess the Los Osos System's ability to meet current and future water needs and recommend system upgrades needed to meet current customer needs. This assessment is developed by using hydraulic design criteria, water quality standards, system demands and available supply, and facility condition assessments.

Specifically, this master plan supports GSWC's effort to update existing master plans and hydraulic models for water systems throughout the company. These updates provide GSWC with a baseline for determining the impacts of new development on existing systems as well as identifying short, mid, and long term system needs. These system needs are used as the basis for developing the capital improvement program (CIP) for the system. The primary drivers of this master plan update are the following:

- Assess the distribution system's hydraulic performance
- Identify infrastructure that is in poor condition and needs to be replaced
- Identify supply and storage needs
- Identify water quality and treatment needs
- Provide documentation for the proposed CIP projects in support of the General Rate Case for the California Public Utilities Commission (CPUC)
- Reduce operations and maintenance (O&M) efforts and costs required to maintain service under current conditions
- Minimize service failures

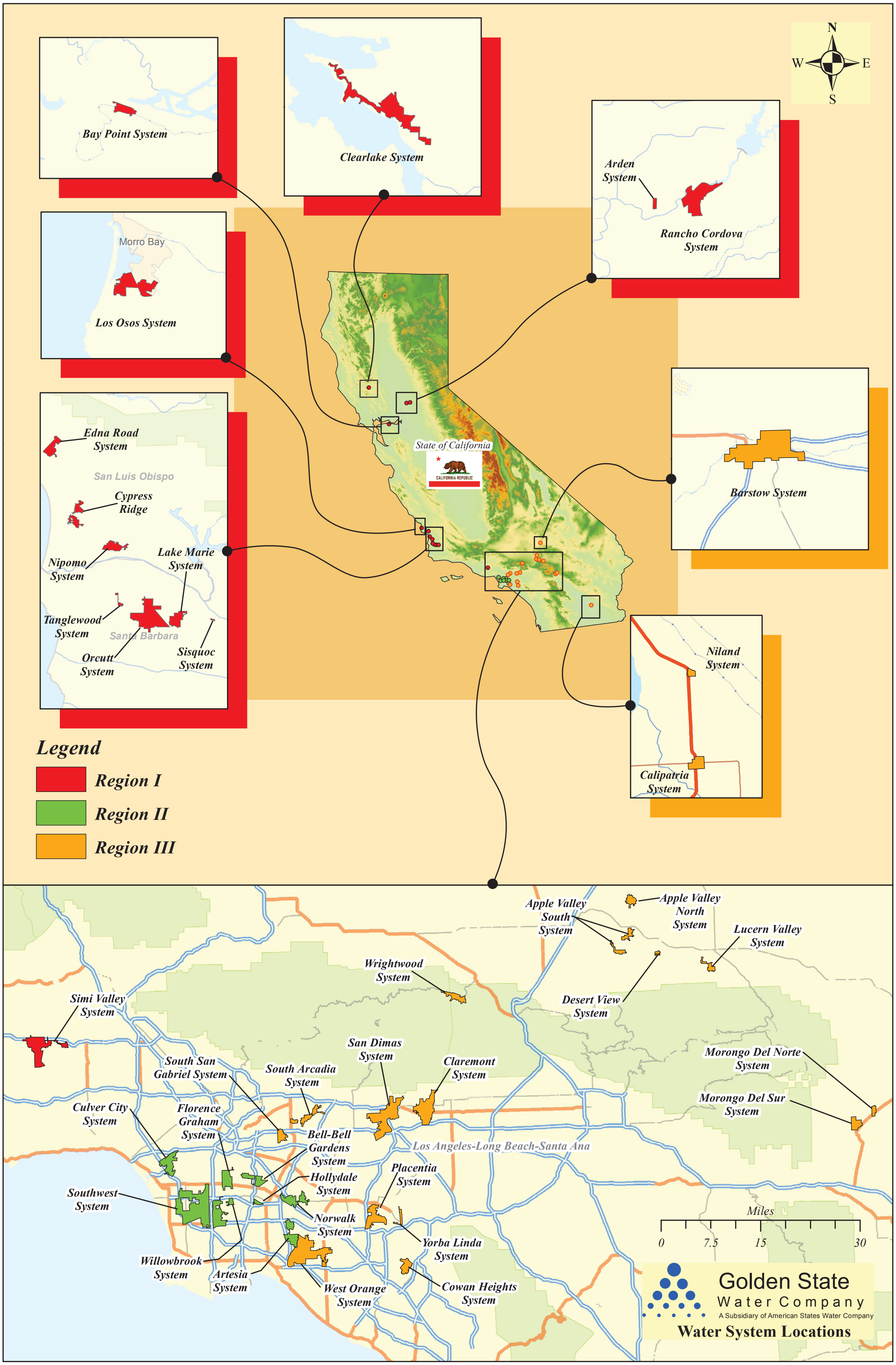
1.3 Document Organization

This master plan document is organized to provide information in a sequential manner that considers historical progression (past to present to future) and logical evaluation of the system from existing facilities and requirements through future needs. Each section's title and a brief summary are as follows:

1. **Introduction:** Provides background information on the company and its systems.
2. **Existing Water System Facilities:** Provides an overview of the system and its facilities. System facilities identified include the system service area boundary, pressure zones, distribution areas, supply sources, storage facilities, pump stations, pressure regulating and water control stations, and transmission and distribution pipelines.
3. **Existing and Future Demands:** Provides definition of demand types and periods, as well as existing and future demands. Explains the demand development approach and determination of peaking factors. Provides the current demands and projected demands developed for a future 2040 condition. Future demands are based on population growth rate and water use projections.
4. **Hydraulic Model Development and Calibration:** Provides an overview of the modeling process, including hydraulic model construction and calibration.
5. **Supply and Storage Capacity Evaluation:** Documents the evaluation of the system's water supply and storage capacity using the objectives identified in GSWC's *Master Planning Criteria and Standards.* The evaluation results establish supply and storage needs for each distribution area and the entire distribution system. Existing and future supply and storage deficiencies are also identified. Recommended improvements to mitigate deficiencies are also provided.
6. **Hydraulic Analysis and Evaluation:** Outlines the approach for the hydraulic analysis. Details how the updated hydraulic model was used to determine hydraulic deficiencies under simulated demand scenarios and was compared with the analysis and planning criteria for short, mid, and long term planning periods. Provides recommendations to address deficiencies that were identified. Scenarios simulated by the hydraulic model include average day, maximum day, and peak hour conditions.
7. **Water Quality Analysis:** Provides GSWC's evaluation of water quality based on current and pending federal and state standards and rules.
8. **System Condition Assessment:** Provides GSWC's documentation of system condition assessment efforts including past efforts, recent field inspections, and recommendations for future improvements.
9. **Capital Improvement Program:** Describes the CIP plan resulting from all preceding tasks broken down into short, mid, and long term planning periods. This includes prioritization and justification for the projects included in the CIP.
10. **References:** Lists the primary sources of information referred to throughout the master plan.

Appendices provide supporting information on various specifications and details referred to throughout the master plan.

Figures



GSWC Engineering Planning October 2017

SECTION 2

Existing Water System Facilities

This section documents existing water system facilities for the Los Osos System. Detailed information about the major facilities, such as water supply facilities, storage facilities, pipelines, pumping facilities, and regulating valves serves as the basis for subsequent system analysis throughout the master plan. This section begins with an overview of the system, and then presents detailed information about these facilities.

2.1 Overview

The Los Osos System is located in San Luis Obispo County, covers approximately 2.4 square miles, and serves the community of Baywood–Los Osos.

Water supply for the Los Osos System is provided entirely by groundwater from the Upper and Lower aquifers. There are no purchased water supply connections. The system has one emergency interconnection with Los Osos Community Services District (LOCSD).

The system has approximately 34 miles of pipelines that range from diameter 2 to 14 inches.

2.2 Facility Descriptions

The major system facilities are shown in FIGURE 2-1 at the end of this Section. These facilities are discussed in detail in the following subsections:

- Pressure zones
- Supply sources
- Storage facilities
- Pumping stations
- Pressure regulating stations and flow control stations
- Transmission and distribution pipelines

2.2.1 Pressure and Distribution Zones

The Los Osos System is comprised of ten pressure zones. The Los Osos System's customer service area (CSA) ranges in elevation from 14 to 577 feet above mean sea level (msl). TABLE 2-1 provides details of these pressure zones and lists the PRVs and/or booster stations that connect the zones. The majority of the system is located in the Bayview Heights Reservoir Zone. FIGURE 2-2 presents the system's hydraulic profile (schematic of the water system).

TABLE 2-1 Pressure Zone Details

Pressure Zone	HGL (ft msl)	Elevations Served (ft msl)	Supply and Storage Facilities*		PRV/Booster Station
			Storage Tanks	Wells and Purchased Water	
Bayview Booster	472	223–363	-	-	Check valve from Calle Cordoniz Reservoir Zone,

Zone					Bayview Boosters A & B
Bayview Heights Reservoir Zone	260	21–185	Bayview Reservoir, Los Olivos Reservoir	Los Olivos Wells #3 & #5, Skyline Well #1, South Bay Well #1, Rosina Well #1 and Cabrillo Well #1	PRV from Lower Rodman Zone, 2 PRVs from Calle Cordoniz Reservoir Zone, PRV from Highland Zone Los Olivos Booster Station
Calle Cordoniz Reservoir Zone	395	167–250	Calle Cordoniz Reservoir	-	Check valve from Bayview Heights Reservoir Zone, Bayview Boosters C & D
Highland Zone	291	157–200	-	-	Check valve from Bayview Heights Reservoir Zone, PRV from Calle Cordoniz Reservoir Zone
Cuesta Zone	186	14–66	-	-	4 PRVs from Bayview Heights Reservoir Zone
Alamo Reservoir Zone	650	350–577	Alamo Reservoir, Cabrillo Reservoir	-	Cabrillo Booster Station
Upper Rodman Zone	585	268–437	-	-	PRV from Alamo Reservoir Zone, Check valve from Middle Rodman Zone
Middle Rodman Zone	548	254–391	-	-	PRV from Alamo Reservoir Zone
Lower Rodman Zone	444	146–325	-	-	PRV from Middle Rodman Zone
Sea Oak Zone	333	164–362	-	-	PRV from Calle Cordoniz Reservoir Zone, Check valve from Bayview Heights Zone

* Does not include hydropneumatic tanks or emergency interconnections.

2.2.2 Supply Sources

GSWC currently obtains its water supply for the Los Osos System from one primary source: GSWC owned and operated groundwater wells. The Los Osos System also has one emergency interconnection.

Groundwater

The Los Osos System has six active and one non-operational well; their locations are identified in FIGURE 2-1. The wells draw water from two aquifers, an Upper Aquifer and a Lower Aquifer. The Upper Aquifer has high level of nitrates (caused, primarily, by septic tanks in the area) but low total dissolved solids (TDS) levels. A wastewater system and treatment plant were recently installed in the Los Osos community; therefore, the septic tanks are now abandoned, which may help mitigate the rising nitrate levels. The Lower Aquifer has high TDS and potential seawater intrusion. These water quality issues affect GSWC's ability to utilize some wells.

The groundwater from active wells meets most state and federal water quality standards; treatment is required at some of the well facilities. After disinfection using sodium hypochlorite, the water from the wells is pumped directly into the distribution system or into nearby reservoirs.

Active Wells

Six groundwater wells were identified as active for this master plan. TABLE 2-2 presents the relevant data for these wells. The elevation shown for each well is the elevation of the wellhead facilities. The pumping water level is the depth measured from the wellhead to the surface of the groundwater while the well pump is running. Pumping water levels were based on recent levels monitored and recorded by GSWC. The groundwater elevation was calculated by subtracting the pumping water level from the wellhead elevation. Well capacities are based on facility design capacities, which may vary slightly with recent pump test data. Total dynamic head (TDH) represents the amount of energy required by the pump to produce water at the given flow rate. The discharge location describes where the well pump discharges.

TABLE 2-2 Active Wells

Well	Discharge Location	Wellhead Elevation (ft msl)	Pumping Water Level (ft)	Pumping Groundwater Elevation (ft msl)	TDH[a] (ft)	Capacity[b] (gpm)
Cabrillo #1[c]	Cabrillo Plant	179	214	-35	280	220
Los Olivos #3	Los Olivos Reservoir	120	160	-40	345	150
Los Olivos #5	Los Olivos Reservoir	123	188	-65	271	150
Rosina #1[d]	Bayview Heights Reservoir Zone[e]	93	250	-157	400	385
Skyline #1	Bayview Heights Reservoir Zone[e,f]	23	42	-19	308	180
South Bay #1	Bayview Heights Reservoir Zone	143	226	-83	400	250
Total groundwater production capacity						**1,335**

msl: above mean sea level

[a] TDH is based on pump design point data.
[b] Capacity is based on facility design capacity, under normal operating conditions, and may not reflect actual capacity at a given point in time.
[c] As of the publication date of this Master Plan, the Cabrillo well is having sand production problems due to holes in the casing, and the pump has been pulled.
[d] The Rosina well has experienced a significant loss in yield; 2018 pump test results show the normal operating point as 217 gpm @ 508 ft TDH.
[e] The Rosina and Skyline wells are blended at the Rosina Plant before entering the distribution system; both wells can operate independently.
[f] The Skyline well pumps through a transmission main and IX facility (located at the Rosina Plant site) before entering the distribution system.

Non-operational Wells

The Los Osos System has one non-operational well. A summary is provided in TABLE 2-3.

TABLE 2-3 Non-operational Wells

Well	Discharge Location	Elevation (ft msl)	Previous Capacity (gpm)	Reason
Pecho #1	Bayview Heights Reservoir Zone	69	450	Seawater intrusion, mechanical issues

Purchased Water

There are no existing purchased water connections for the Los Osos System.

TABLE 2-4 Imported Water Supply Connections

Imported Water Supply Connection	Hydraulic Grade Line (ft)	Capacity (gpm)	Pressure Setting at Connection* (psi)	Ground Surface Elevation (ft msl)	Imported Water Supply Pipeline
-	-	-	-	-	-

* The fixed-head elevation at the service connection is calculated as the sum of the elevation of the centerline of the control valve and the pressure head from the pressure setting.

Emergency Interconnections

Water distribution systems are often connected to neighboring water systems to allow the sharing of supplies during short-term emergencies or during planned shutdowns of a primary supply source. The Los Osos System has one interconnection which is "normally closed" and must be manually opened to provide flow. This emergency interconnection is presented in TABLE 2-5.

TABLE 2-5 Emergency Interconnections

Interconnection Name/Location	Capacity* (gpm)	Notes
Los Olivos Ave. and 11th St.	300	6-inch interconnection with Los Osos Community Services District (LOCSD)

* Capacity of an emergency interconnection is not considered a reliable supply; rather, it is considered an "interruptible" supply, as it is based on whether or not the neighboring water agency has available water.

2.2.3 Storage Facilities

Water distribution systems rely on stored water to help equalize fluctuations between supply and demand, to supply sufficient water for firefighting, and to meet demands during an emergency or an unplanned outage of a major supply source. This section describes the existing storage facilities in the system.

Storage Tanks

The Los Osos System has five reservoirs. Two reservoirs, Alamo and Calle Cordoniz, are at elevations that use gravity to pressurize zones they serve. Water for the Alamo Reservoir is provided through the Cabrillo Plant Booster Station. The Calle Cordoniz Reservoir receives its water from the Bayview Plant Booster Station. The Cabrillo and Los Olivos Reservoirs provide ground level storage that requires pumping into the distribution system; the Cabrillo Reservoir is filled by Cabrillo Well #1 and water from the Bayview Heights Reservoir Zone; the Los Olivos Reservoir is filled by Los Olivos Wells #3 and #5 and, if needed, water from the Bayview Heights Reservoir Zone via a solenoid controlled altitude valve. The Bayview Reservoir feeds the Bayview Heights Zone by gravity, and the Calle Cordoniz Reservoir Zone and Bayview Booster Zone by pumping from ground-level storage. This reservoir receives water from the Bayview Heights Reservoir Zone that is normally fed from wells (South Bay #1, Skyline #1 and Rosina #1), and boosted water from the Los Olivos Reservoir. Cabrillo Well #1 can feed the Bayview Heights Reservoir Zone directly with valve manipulation. TABLE 2-6 provides relevant details for these reservoirs.

TABLE 2-6 Storage Tanks

Tank/ Reservoir	Type and Zone	Bottom of Reservoir (ft msl)	High Water Elevation (ft msl)	Reservoir Height (ft)	Diameter (ft)	Volume (MG)
Alamo	Ground level, gravity to Upper Rodman, Middle Rodman, and Lower Rodman Zones	640.0	655	16.5	29.5	0.08
Bayview	Ground level pumped to Calle Cordoniz Reservoir Zone and Bayview Booster Zone, gravity to Bayview Heights Reservoir Zone	250.0	263.5	15.0	50.0	0.22
Cabrillo[a]	Ground level pumped to Alamo Reservoir Zone	171.0	186	16.0	21.5	0.04
Calle Cordoniz	Ground level, gravity to Calle Cordoniz Reservoir Zone	385.0	400	16.0	55.0	0.25
Los Olivos	Ground level pumped to Bayview Heights Reservoir Zone	115.0	133	24.0	70.0	0.50
Total systemwide storage capacity						**1.10**

[a] The Cabrillo Tank acts as a forebay for Cabrillo Boosters A-C, and may be bypassed/abandoned in the near future with construction of a larger Alamo Tank. If it is bypassed or abandoned, the capacity/reliability of the suction side of the booster station can be increased by adding a secondary feed.

2.2.4 Pumping Stations

Pumping stations are required to convey water from ground-level tanks into the distribution system or from lower-pressure zones into higher-pressure zones (usually called booster pumping stations). Pumping stations may consist of one or more individual pumps. Multiple pumps at each station, or multiple pumping stations that serve the same pressure zone, help to increase water system reliability by ensuring that water can still be delivered into that zone if one pump is out of service. Critical pumping stations may be equipped with emergency power supplies in case of failure of the primary power source.

The Los Osos System has nine booster pumps, located at three active booster stations. The Bayview Plant has four booster pumps and a generator connection. The Cabrillo Plant has three booster pumps, with a diesel driven generator that is sized to supply backup electrical power for all three boosters running at the same time. The Los Olivos Plant has two booster pumps, one of which is natural-gas powered. TABLE 2-7 presents pump data relevant to the water system analysis.

TABLE 2-7 Booster Pumps

Pump	Pressure Zone		Backup Power Available	Elevation (ft msl)	TDH[a] (ft)	Capacity[b] (gpm)
	Suction	Discharge				
Bayview A	Bayview Heights Reservoir	Bayview Booster Zone	-	252	245	82
Bayview B	Bayview Heights Reservoir	Bayview Booster Zone	-	252	245	82
Bayview C	Bayview Heights Reservoir	Calle Cordoniz Reservoir Zone	-	252	170	500
Bayview D	Bayview Heights Reservoir	Calle Cordoniz Reservoir Zone	-	252	170	500
Cabrillo A	Cabrillo Reservoir	Alamo Reservoir and Upper Rodman Zones	Diesel Generator	175	555	250
Cabrillo B	Cabrillo Reservoir	Alamo Reservoir and Upper Rodman Zones	Diesel Generator	175	555	250
Cabrillo C	Cabrillo Reservoir	Alamo Reservoir and Upper Rodman Zones	Diesel Generator	175	555	500
Los Olivos A	Los Olivos Reservoir	Bayview Heights Reservoir Zone	Natural Gas	125	160	300
Los Olivos B	Los Olivos Reservoir	Bayview Heights Reservoir Zone	-	125	160	500

msl: above mean sea level

[a] TDH is based on pump design point data.
[b] Capacity is based on facility design capacity.

2.2.5 Pressure Regulating and Flow Control Stations

Pressure regulating and flow control stations allow distribution systems to transfer water from higher pressure zones to lower pressure zones without exceeding the allowable pressures in the lower zones or completely depressurizing the higher zone. The water is transferred through a valve that reduces the pressure or controls the flow rate to a specified setting. Regulating valves can operate based on one or more controlling parameters. The operational controls important to this analysis include pressure reducing, pressure sustaining, pressure relief, and flow rate:

- **Pressure reducing valve:** modulates to maintain a preset minimum downstream pressure setting; if the downstream pressure drops, then the valve will open until the downstream pressure matches the pressure setting.
- **Pressure sustaining valve:** modulates to maintain a preset minimum upstream pressure setting; if the upstream pressure drops, then the valve will close until the upstream pressure matches the pressure setting.

- **Pressure relief valve:** opens when the upstream pressure exceeds a preset maximum pressure setting.
- **Flow control valve:** modulates to maintain a preset flow rate through the valve regardless of pressure.

TABLE 2-8 provides relevant data for 16 pressure-regulating valves in the Los Osos System.

TABLE 2-8 Pressure Regulating and Flow Control Valves

Name/Location	Pressure Zone		Type	Dia. (in)	Setting (psi)	Maximum Capacity[a] (gpm)
	Upstream	Downstream				
Bayview Plant	Bayview Booster Zone	Bayview Heights Reservoir	Relief Valve	6	92	1,800
Cabrillo Plant	Bayview Heights Reservoir Zone	Cabrillo Reservoir	Altitude Valve	6	N/A	1,800
Los Olivos Plant	Bayview Heights Reservoir Zone	Los Olivos Reservoir	Altitude Valve	6	60	1,800
Bay Oaks Dr., west of Crest Ave.	Calle Cordoniz Reservoir Zone	Bayview Heights Reservoir Zone	PRV	6	38	880
Oakridge Dr., north of Bay Oaks Dr.	Calle Cordoniz Reservoir Zone	Bayview Heights Reservoir Zone	PRV	8	45	880
Sea Oaks (end of Bay Oaks Dr.)	Calle Cordoniz Reservoir Zone	Sea Oak Zone	PRV	4	62	800
Rodman Dr. and Pecho Valley Rd.	Lower Rodman Zone	Bayview Heights Reservoir Zone	PRV	4	45	800
Rodman Dr. north of Travis Dr.	Middle Rodman Zone	Lower Rodman Zone	PRV	6	80	1,565
Rodman Dr., south of San Jacinto Dr.	Alamo Reservoir Zone	Middle Rodman Zone	PRV	6	68	1,565
Travis Dr., north of Houston Dr.	Alamo Reservoir Zone	Upper Rodman Zone	PRV	6	84	880
Skyline Dr., east of Pecho Rd.	Bayview Heights Reservoir Zone	Cuesta Zone	PRV	4	70	800
Doris Ave., south of Skyline Dr.	Bayview Heights Reservoir Zone	Cuesta Zone	PRV	4	62	390
Fearn Ave., north of Skyline Dr.	Bayview Heights Reservoir Zone	Cuesta Zone	PRV	4	63	390
Pine Ave., north of Skyline Dr.	Bayview Heights Reservoir Zone	Cuesta Zone	PRV	6	60	390
Highland Dr., west of Doris Ave.	Highland Zone	Bayview Heights Reservoir Zone	PRV/PSV/Relief Valve	4	40/50/75	800
Bayview Heights Dr. and Highland Dr.	Calle Cordoniz Reservoir Zone	Highland Zone	PRV/PSV & 2" PRV Bypass	6	40/50/46	1,565

[a] Maximum capacity determined by lesser of 1) PRV capacity or 2) upstream/downstream pipeline size (flow at 10 ft/s).

2.2.6 Transmission and Distribution Pipelines

The Los Osos System has a total of approximately 34 miles of pipe ranging in diameter from 2 to 14 inches in diameter. TABLE 2-9 lists the estimated footage of pipelines by diameter and material.

TABLE 2-9 Pipes by Size and Material

Diameter (in)	Length of Pipe by Material (ft)			Total Length (ft)
	AC	DI	PVC	
2	-	-	1,941	**1,941**
4	36,438	979	340	**37,758**
6	49,685	2,300	9,025	**61,010**
8	37,095	19,098	19,361	**75,554**
10	-	-	2,185	**2,185**
12	-	737	718	**1,455**
14	338	-	-	**338**
Totals (ft)	123,556	23,115	33,570	**180,241**
Totals (mi)	23.4	4.4	6.4	**34.1**
Percent (%)	68.6	12.8	18.6	**100**

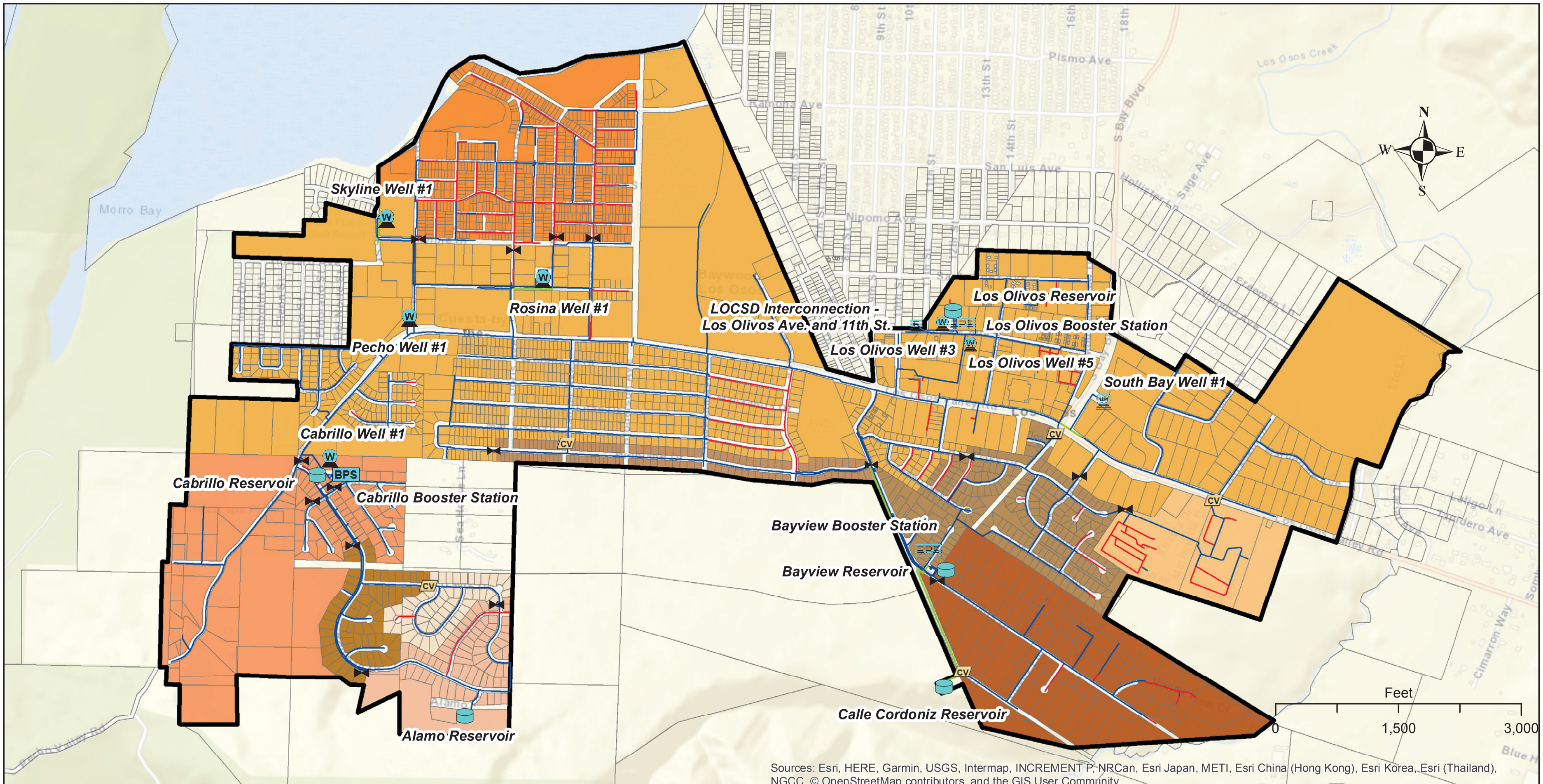
AC: asbestos cement or transite PVC : polyvinyl chloride
DI : ductile iron

TABLE 2-10 lists the estimated footage of pipelines by diameter and year constructed.

TABLE 2-10 Pipes by Size and Year Built

Diameter (in)	Length of Pipe by Year Built (ft)			Total Length (ft)
	1960-1979	1980-1999	2000-2019	
2	1,818	124	-	**1,941**
4	27,275	9,608	875	**37,758**
6	29,810	30,228	971	**61,010**
8	20,629	39,643	15,283	**75,554**
10	-	2,185	-	**2,185**
12	-	-	1,455	**1,455**
14	338	-	-	**338**
Totals (ft)	79,870	81,787	18,584	**180,241**
Totals (mi)	15.1	15.5	3.5	**34.1**
Percent (%)	44.3	45.4	10.3	**100**

Figures



Existing Facilities

- BPS Booster Pump Station
- Reservoir
- Well
- CV Check Valve
- Regulating Valve
- E Emergency Interconnection

Pipelines

- Less than 6"
- 6" or 8"
- 10" or Greater

Pressure Zones

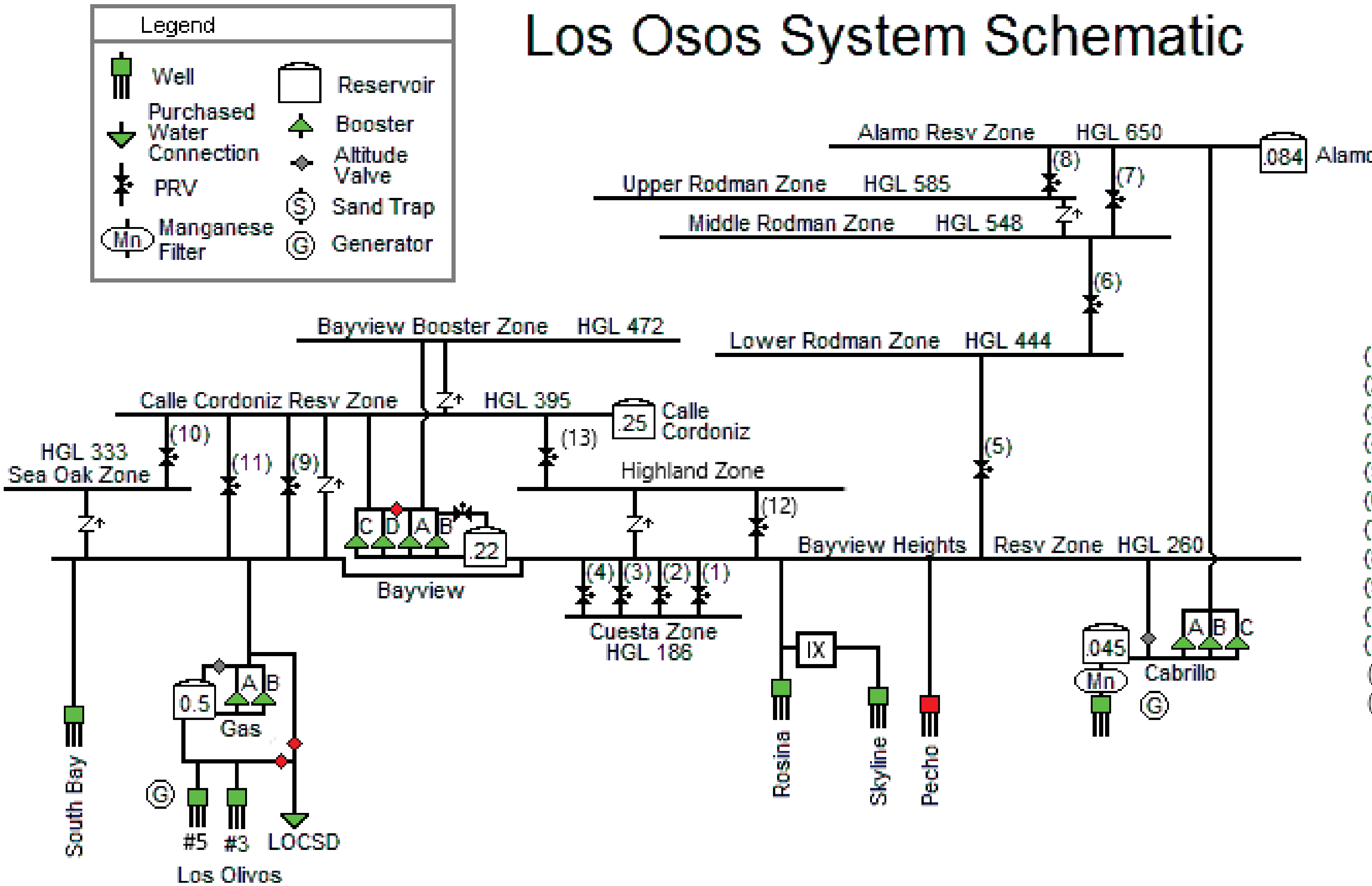
- Alamo
- Bayview Booster
- Bayview Heights
- Calle Cordoniz
- Cuesta
- Lower Rodman
- Middle Rodman
- Upper Rodman
- Sea Oak
- Highland
- Los Osos System Boundary

FIGURE 2-1
MAJOR SYSTEM FACILITIES
GSWC REGION I MASTER PLAN
LOS OSOS SYSTEM

Golden State Water Company
A Subsidiary of American States Water Company

Last Update: 3/1/2019

Los Osos System Schematic



PRV Stations

(1) - Pecho & Skyline
(2) - Doris & Skyline
(3) - Fearn & Skyline
(4) - Pine & Skyline
(5) - Rodman & Pecho Valley
(6) - Rodman N/ Travis
(7) - Rodman S/ San Jacinto
(8) - Travis & Houston
(9) - Oak Ridge N/ Bay Oaks
(10) - Bay Oaks Dr Extension
(11) - Bay Oaks & Crest
(12) - Highlnad w/ Doris
(13) - Highland & Bayview Heights

FIGURE 2-2
SYSTEM SCHEMATIC
GSWC REGION I MASTER PLAN
LOS OSOS SYSTEM

Golden State Water Company
A Subsidiary of American States Water Company

SECTION 3

Existing and Future Water Demands

This section documents existing and future water demands for the system and contains the following information:

- Demand definitions and scenarios
- Existing demands
- Peaking factors
- Future demand projections

3.1 Demand Definitions and Periods

Demand is classified in two basic ways:

- Demand: The total quantity of water required for a given period of time to meet the water system's various uses. These uses may include residential, commercial, industrial, and other revenue and non-revenue demands.
- Non-revenue water: The difference between the total amount of water produced from water supply sources and the total amount of water delivered to customers. This includes water used for firefighting, flushing, water lost due to system leaks and illegal connections. For systems without meters for all customers, this demand classification may not be quantifiable.

The water industry commonly uses several demand periods for developing water distribution system master plans. These demand periods are designated as average day demand (ADD), maximum day demand (MDD), peak hour demand (PHD), and maximum day demand plus fire flow (MDD+FF), and were applied as necessary to evaluate the system. The American Water Works Association (AWWA, 2005) defines these common steady-state demand periods as follows:

- ADD: Total amount of water delivered to the system in 1 year divided by 365 days.
- MDD: Maximum amount of water delivered to the system in any single day of the year.
- PHD: Amount of water required to meet peak demands during MDD. GSWC applies PHD for four hours when analyzing system supply and storage.
- MDD+FF: Amount of water required to fight a fire in addition to MDD.

3.2 Existing Demands

The existing demands represent a baseline for evaluating the existing system and to project future demands. The data used to develop the existing demands was based on historical water production data provided by GSWC.

3.2.1 Historical Water Use

For this master plan, it was assumed that the historical water production equaled the historical water demand (including non-revenue water). TABLE 3-1 summarizes historical annual water production from 2009 through 2018. The average water demand per connection for this period was 0.231 acre-feet per year per connection (AFY/conn.).

TABLE 3-1 Historical Annual Water Production

Year	Active Service Connections	Total Demand (AFY)*	Average Demand per Connection (AFY/conn.)
2009	2,680	892	0.333
2010	2,673	772	0.289
2011	2,678	737	0.275
2012	2,667	701	0.263
2013	2,670	688	0.258
2014	2,677	564	0.211
2015	2,672	469	0.176
2016	2,686	449	0.167
2017	2,698	450	0.167
2018	2,703	464	0.171
10-year average			**0.231**

* Includes non-revenue water use

FIGURE 3-1 summarizes the historical annual water production and number of active service connections. The figure demonstrates a correlation between the number of active service connections and the amount of water consumed. The average demand per connection varied between 0.167 and 0.333.

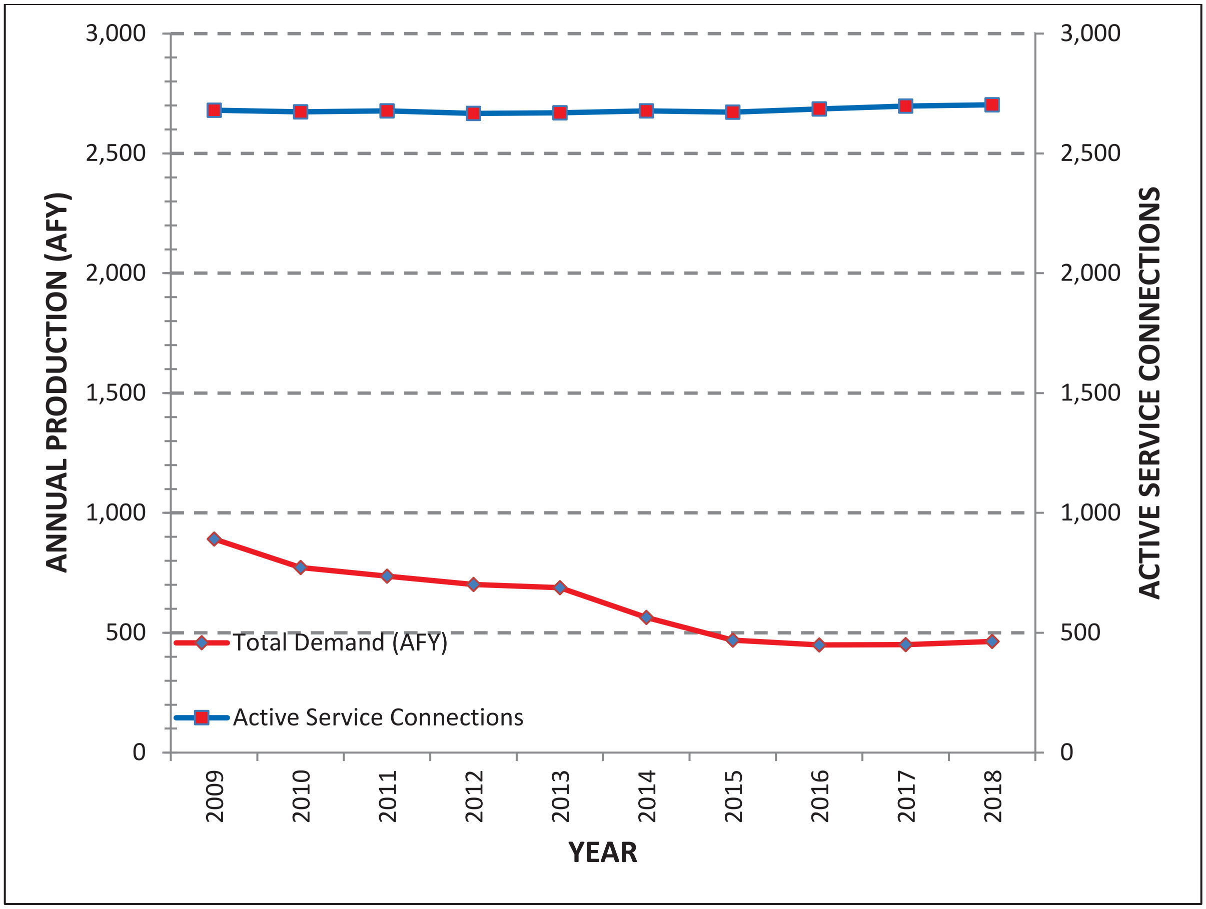


FIGURE 3-1 Historical Annual Production Totals and Active Service Connections for the Last 10 Years

3.2.2 Establishing Demands

The total water demand for existing conditions was estimated by multiplying the number of 2018 active service connections (2,703) with the 10-year average of the average demand per service connection (0.231 AFY/conn.), resulting in a system water demand of 624 AFY. Converting the system water demand to a daily demand produces an ADD of 387 gpm. This approach allows the calculation of ADD for various planning years, including the impact on anticipated growth, and then allows a direct calculation for other demand periods using the appropriate peaking factor.

To evaluate the system's performance during the MDD scenario, existing historical demand data were used in accordance with the Waterworks Standards set forth by the California Code of Regulations (2009). Section 64554.30 of the Waterworks Standards define MDD as "the amount of water utilized by customers during the highest day of use (midnight to midnight), excluding fire flow, as determined pursuant to Section 64554." Section 64554(b)(1) of the Waterworks Standards states "…identify the day with the highest usage during the past ten years to obtain MDD…". While GSWC is currently unable to track customer usage over an exact 24-hour period, GSWC does record daily water production – and, as stated in Master Plan Section 3.2.1, above, it can be "assumed that the historical water production equal[s] the historical water demand". However, because the daily production reads are not taken at midnight or always collected at the same time each day, the resulting data may be for time periods that can range anywhere from 16 to 32 hours (depending on the time of day the production data are collected). For example, the readings may be taken at 9am one day and 4pm the next; this introduces the chance of a fairly large error if only the recording for a single day is used, as it could include water production over a period longer than 24 hours. To address the possible variations in the hours per day within a given production read, GSWC identifies and uses the average of the three consecutive days with the highest production for each calendar year. By utilizing the average of these highest three consecutive days of water production, the resulting number is normalized, reducing the effect of any imprecision due to the time of day when the data was collected.

Table 3-2 presents the ADD, MDD, and peaking factor data over the last ten years.

TABLE 3-2 Historical Average and Maximum Day Demand

	ADD[a]			
Year	**AFY**	**gpm**	**MDD[b] (gpm)**	**MDD Peaking Factor (MDD:ADD)**
2009	892	553	801	1.45
2010	772	478	719	1.50
2011	737	457	662	1.45
2012	701	435	630	1.45
2013	688	427	577	1.35
2014	564	350	470	1.34
2015	469	291	386	1.33
2016	449	278	417	1.50
2017	450	279	385	1.38
2018	464	287	409	1.42

[a] Includes non-revenue water use
[b] Average of three consecutive highest days

Peaking factors are typically calculated as a ratio of the demand period to ADD. For example, to determine the MDD peaking factor you would divide the MDD by the ADD. Peaking factors are used to estimate future water demands as presented and discussed in Section 3.3. To determine the existing MDD, the Waterworks Standards state the following in Section 64554(b):

> *A system shall estimate MDD and PHD for the water system as a whole (total source capacity and number of service connections) and for each pressure zone within the system (total water supply available from the water sources and interzonal transfers directly supplying the zone and number of service connections within the zone), as follows:*
>
> *(1) If daily water usage data are available, identify the day with the highest usage during the past ten years to obtain MDD; determine the average hourly flow during MDD and multiply by a peaking factor of at least 1.5 to obtain PHD.*

According to TABLE 3-2, the highest MDD during the past ten years was 801 gpm, which occurred in 2009. Multiplying the MDD by a peaking factor of 1.5 results in a PHD of 1,202 gpm. It has been GSWC's experience that utilizing a peaking factor of 1.5 has been sufficient to meet PHD. Projected system demands for the ADD, MDD, and PHD scenarios are summarized in TABLE 3-3.

TABLE 3-3 Projected System Demands by Demand Period

Demand Period	GPM
ADD	387
MDD	801
PHD	1,202

3.3 Future Demand Projections

Future demands were projected first to estimate future ADD, and then peaking factors were applied to estimate MDD and PHD. The following sources of data and approaches were used:

- Growth-rate projections
- Water-demand projections

3.3.1 Growth Rate Projections

Growth rate projections were evaluated against equivalent estimates in the previous Los Osos System Water Master Plan and year 2010 U.S. census data to correlate population growth with the increase in service connections. This correlation was then used to determine future water demand.

3.3.2 Water Demand Projections

The projected annual water demands were extrapolated to year 2040 to determine the projected water use. Due to ongoing groundwater basin issues in the Los Osos area (see Section 2.2.2 discussion of Upper Aquifer and Lower Aquifer water quality) and customer awareness of conservation needs, no rate of growth in annual water demands is anticipated.

FIGURE 3-2 presents the historical and projected annual water demands, including the most recent 10-year period. Projections of future demands are equal to the existing demand (2019) of 624 AFY.

The State of California is in a long term drought and the Governor has issued Executive Orders that will likely result in significant reductions in future demands. This Master Plan utilizes the current requirements established by the State of California and California Public Utilities Commission in evaluating needed facilities but acknowledges that the requirements may change. Subsequent updates to this Master Plan will reflect future changes in requirements.

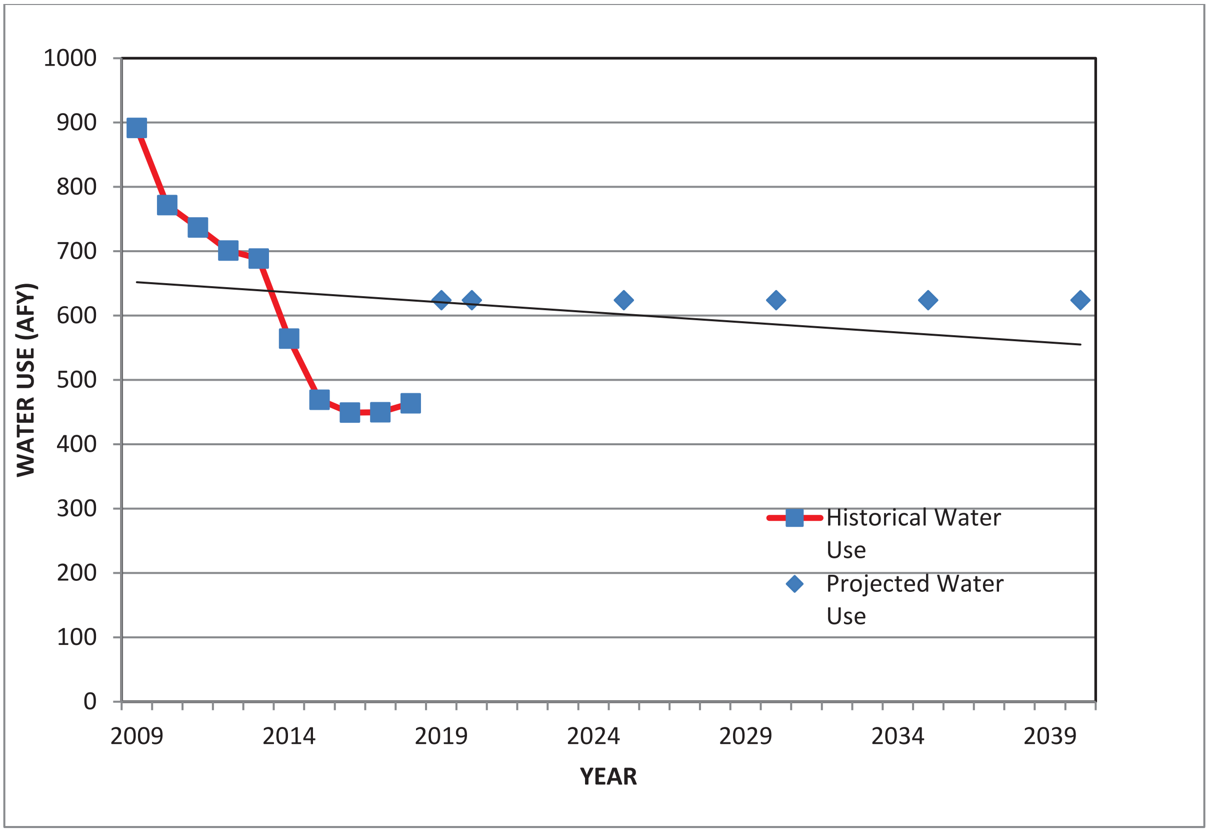


FIGURE 3-2 Historical Water Demand and Future Water Demand Projections

The water demands for 2040 project to be 624 AFY, resulting in an ADD of 387 gpm. To determine the projected MDD for year 2040, a peaking factor from TABLE 3-2 was applied to the projected ADD. The peaking factor associated with the highest MDD during the past ten years, 1.45 in 2009, was selected, resulting in a MDD of 561 gpm. A peaking factor of 1.5 was multiplied by the projected MDD to determine the projected PHD, which is 842 gpm. TABLE 3-4 summarizes the projected demands for ADD, MDD, and PHD periods.

TABLE 3-4 Water System Demands by Demand Period

	Demand Period and Peaking Factor			
Planning Year	**Annual Average (AFY)**	**ADD (gpm)**	**MDD (gpm)**	**PHD (gpm)**
2019	624	387	801	1,202
2040	624	387	561	842

SECTION 4

Hydraulic Model Development and Calibration

4.1 Overview

A computerized hydraulic model of a water distribution system is an important tool used as part of the Water Master Plan to conduct hydraulic analyses of the water system.

The computer model is used to analyze the facilities, operational characteristics, and water supply and consumption data of a water system. The water distribution system hydraulic model includes pipes, junction nodes (connection points for pipes and location of demands), valves, wells, pumps, purchased water connections, tanks, and reservoirs. Operational characteristics include parameters that control the method by which the water is distributed through the system, such as on and off settings for pumps, pressure or flow controls for hydraulically actuated valves, or main line valve closures. Data for supply and consumption determine where the water supply and demands are applied within the modeled distribution system.

Accurate computer model development begins with entering the correct information into the data file and calibrating the model to match existing conditions in the field. Once this foundation is complete, the resulting model becomes an invaluable tool. It can simulate the existing and future water system, identify system deficiencies, analyze impacts from increased demands, and determine the effectiveness of proposed improvements.

4.2 Construction and Calibration of the Hydraulic Computer Model

The Los Osos System hydraulic computer model was revised as part of the 2016 Master Plan. For this Master Plan, the model was checked for accuracy and updated to include newly constructed facilities. Valve settings for pressure regulating valves were also verified, and the system demands were validated. Localized calibration was performed to refine the model in certain sections of the system.

4.3 Summary

This Master Plan update included verification of the physical components represented in the hydraulic model, validation of demands in the model, and localized field testing and calibration.

It is important to note that model calibration for any water system is an ongoing effort. As changes in the system occur from changing demands, new infrastructure development, or changing operational settings, the model must be periodically updated and checked to ensure agreement with field measurements. This update serves as a baseline for future calibration efforts by GSWC.

SECTION 5

Supply and Storage Capacity Evaluation

This section documents the evaluation of the water supply and storage capacity for the Los Osos System. The evaluation results accomplished the following:

- Established storage needs for each pressure zone and the entire distribution system
- Identified supply and/or storage deficiencies in the existing and future systems
- Proposed improvements that mitigate the deficiencies identified

In each subsection, the supply and storage capacity of the existing and future water systems were measured against the objectives identified in the technical memorandum titled *Master Planning Criteria and Standards* (see Appendices). When the analysis indicated that the system did not meet these criteria, a deficiency was identified and facilities were proposed to mitigate the deficiency.

5.1 Overview

To provide a reliable water supply, a water system must be able to meet the system demands under a variety of conditions. The water supplied may be provided by a combination of supply sources, or stored water, or both. The specific demand period being analyzed may limit the source of water for the scenario. For example, stored water should not be used to meet ADD or MDD but could be used for PHD or MDD+FF. Therefore, each demand period may require a different ratio of water supplies and storage. This analysis examines various demand periods to determine if the system has the ability to reliably meet the system demands under typical demand scenarios using a combination of water supply sources and storage.

5.2 Evaluation Approach

This supply and storage capacity analysis examined the Los Osos System under two planning periods:

- **Existing (2019) system.** The demands for the existing water system were determined by multiplying the 10 year historical average demand per connection and the most recent number of connections (year 2018) to obtain the total system demand. The analyses assumed all facilities that were operational in 2019.

- **2040 system.** The long-term planning horizon (2040) water system analysis assumed 2040 demands (assumed buildout) and facilities included in the existing system analysis plus facilities needed to correct deficiencies in 2040.

5.2.1 Analysis Criteria

The Los Osos System must be capable of providing sufficient water supply and storage capacity to meet the minimum criteria summarized in TABLE 5-1. These criteria were extracted from the technical memorandum titled *Master Planning Criteria and Standards*.

The criteria apply to the system as a whole and to each pressure zone in the system. For planning purposes, this Master Plan utilizes the Planning Scenario 'MDD + Fire Flow' to analyze the system performance under a worst-case planning scenario. The worst-case planning scenario is represented by applying the single most stringent fire flow requirement established (based on land use plans or as designated by the local fire jurisdiction) for a structure within a hydraulic zone or planning area as the baseline fire flow requirement for the entire hydraulic zone or planning area. For the purposes of the planning analysis, this is considered a goal rather than a requirement. If the result of the worst case planning scenario indicates a deficiency in MDD + Fire Flow, it should be noted that there may not be a deficiency in the actual fire flow requirement for a particular structure, but rather that GSWC is not meeting the planning goal for the overall hydraulic zone or planning area.

TABLE 5-1 Supply and Storage Capacity Analysis Criteria

Planning Scenario	Demand and Duration	Evaluation Criterion	Storage Usage	Facilities Assumed to be Out of Service
Average day	ADD for 24 hours	Total capacity	No storage drawdown	-
Maximum day	MDD for 24 hours	Firm capacity	No storage drawdown	Largest pumping unit in system
Peak hour	PHD for 4 hours[1]	Firm capacity	Operational storage	Largest pumping unit in system
MDD + fire flow	MDD plus fire flow, duration varies[2]	Total capacity	Fire storage	-

[1] Operational storage required to meet peak demands during MDD was defined as the supply needs during 4 hours of PHD.
[2] Fire flow scenarios are based on fire agency maximum flow requirements for a single structure within a planning area and are applied throughout the planning area as part of the planning analysis. Actual fire flows may be less than the maximum fire flow used for planning analysis.

It is worth noting that the California Public Utilities Commission (CPUC) and State Water Resources Control Board, Division of Drinking Water (DDW) currently provide no specific requirements for storage volume. Therefore, recommended standards published by the American Water Works Association (AWWA) were considered in the development of the storage criteria used in this master plan.

5.2.2 Storage

In addition to providing adequate water supplies for the water consumers, water distribution systems often rely on stored water within the distribution system to provide the following operational benefits:

- Help equalize fluctuations between supply and demand.
- Supply sufficient water for firefighting.
- Meet demands during an emergency or unplanned outage of a major supply source.

AWWA defines three types of storage: operational, fire, and emergency. The amount of storage required for each of these types varies by system. Nevertheless, all three types of storage must be considered. In some cases, water stored in the groundwater basin can provide some of this storage. However, when the stored water does not flow by gravity and requires pumping, sufficient pumping redundancy and stand-by power generators must be provided if the storage source is to be considered reliable.

This analysis evaluates the ability of the system's storage facilities to meet the water system's storage requirements. The resulting volume must be allocated to the pressure zones where the demands exist, or to a neighboring zone (if there are pressure-regulating stations or check valves available that allow the water to flow into the neighboring zone). The water system must also be evaluated to determine if existing booster stations provide sufficient water to be pumped into the higher-pressure zones.

TABLE 5-2 presents the recommended operational, fire, and emergency storage criteria as defined by GSWC for the Los Osos System.

TABLE 5-2 Criteria for Calculating Storage

Storage Category	GSWC Criteria
Operational	Storage volume to meet PHD in addition to MDD supply
Fire	Maximum recommended fire storage volume in the system
Emergency	ADD for 12 hours

Operational Storage

The required volume of water for operational storage is determined by the volume needed for regulating the difference between the rate of supply and the daily variations (peaks) in water usage. This difference results in the lowest and highest operating levels in the reservoirs under normal conditions. The resulting volume must be allocated to either the pressure zone (where the demands exist) or to a higher-pressure zone (for use by the lower-pressure zone).

Fire Storage

The volume of water required for firefighting is a function of the instantaneous flow rate required to fight the fire over the duration of the fire flow event as determined by the local fire jurisdiction. Consideration is also made to evaluate the number of fire flow events that may occur before the volume can be replenished. Further, the volume of water necessary to fight a fire can be provided from water supply, water storage, or a combination thereof. For planning purposes, it is desirable and conservative to design the water system to have capacity within water tanks for the volume of water needed for firefighting; however, the fire storage in the tanks plus available supply in excess of MDD can be utilized to meet firefighting requirements. The fire-flow requirements listed in TABLE 5-3 were used to establish the flow rate and duration for each pressure zone; these criteria were used to identify the largest volume of water required for firefighting within each pressure zone (based on the land use in that zone and the flow rates and durations from TABLE 5-3). The resulting fire-flow volumes are shown in TABLE 5-3.

TABLE 5-3 Fire Storage Volumes

Land Use Category	Minimum Fire Flow Required (gpm)	Duration (hr)	Recommended Fire Storage Volume (MG)
Public Facilities, High School	1500	3	0.27
Intermediate / Elementary School	1500	2	0.18
Residential (BV Heights)	1500	2	0.18
Residential (Lower Rodman)	1000	2	0.12
Residential	750	2	0.09

For the Los Osos System, it was assumed that only one fire event within the system would occur before storage tanks could recover. The lowest fire-flow volume (0.135 MG) is the result of a 750-gpm fire for duration of 2 hours (residential land use). The largest fire-flow volume (0.27 MG) is the result of a 1,500-gpm fire for duration of 3 hours (public facility and school land use).

Emergency Storage

Emergency storage is a dedicated source of water that can be used as a backup supply in the event a major supply source is interrupted. This can be provided by water from a second independent source, by water stored in reservoirs, or a combination of both. *Ten States Standards* recommends that emergency storage total between 12 and 24 hours of ADD volume. Because the Los Osos System contains multiple supply sources and a storage reservoir, 12 hours of ADD volume for this system is appropriate.

5.3 Existing System Evaluation

Evaluation of the existing system's supply and storage capacity involved analysis of key system facilities to identify supply or storage capacity deficiencies. This approach involved analyzing multiple proposed improvement alternatives to address these deficiencies. These proposed improvements were then evaluated to determine the most cost-effective alternatives, which would then be identified as the recommended improvements and incorporated into the CIP. The following subsections describe the existing system evaluation:

- Water demands for each demand period
- Supply facilities
- Storage facilities
- Capacity analysis
- Proposed improvements to address deficiencies in the existing system

5.3.1 Existing System Water Demands for Each Demand Period

TABLE 5-4 defines the existing demands by pressure zone for each demand period, based on spatial demand allocation from the Los Osos GIS.

TABLE 5-4 Existing System Water Demands

Pressure Zone	ADD (gpm)	MDD (gpm)	PHD (gpm)	Demand by Zone (%)
Alamo Reservoir Zone	11	23	34	3
Upper Rodman Zone	9	19	29	2
Middle Rodman Zone	10	21	32	3
Lower Rodman Zone	14	30	44	4
Bayview Booster Zone	18	38	57	5
Calle Cordoniz Reservoir Zone	37	176	114	9
Sea Oak Zone	23	48	72	6
Highland Zone	14	28	42	4
Bayview Heights Reservoir Zone	198	410	616	51
Cuesta Zone	52	108	162	13
Total	**387**	**801**	**1,202**	**100**

5.3.2 Existing System Supply Facilities

The existing water supply facilities in the Los Osos System were identified in Section 2, Existing Water System Facilities. TABLE 5-5 summarizes the design production capacity of each supply source and systemwide totals for total capacity.

TABLE 5-5 Existing System Supply Facilities

Facility Name	Source	Pressure Zone	Total Capacity (gpm)
South Bay Well #1	Groundwater	Bayview Heights Reservoir Zone	250
Los Olivos Well #3	Groundwater	Bayview Heights Reservoir Zone	150
Los Olivos Well #5	Groundwater	Bayview Heights Reservoir Zone	150
Rosina Well #1[a]	Groundwater	Bayview Heights Reservoir Zone	385
Skyline Well #1	Groundwater	Bayview Heights Reservoir Zone	180
Bayview Heights Reservoir Zone Total			**1,115**
Cabrillo Well #1	Groundwater	Bayview Heights Reservoir Zone[b]	220
Alamo Reservoir Zone Total			**220**
Systemwide total			**1,335**

[a] This supply source represents the largest capacity facility in the system and was therefore assumed to be unavailable for firm capacity.
[b] This well can pump into the Cabrillo Reservoir or directly into the Bayview Heights Reservoir Zone.

5.3.3 Existing System Storage Facilities

The existing storage facilities in the Los Osos System are described in Section 2, Existing Water System Facilities. TABLE 5-6 summarizes the storage facilities for the Los Osos System.

TABLE 5-6 Existing System Storage Facilities

Facility Name	Primary Pressure Zone Served	Total Capacity (MG)
Los Olivos Tank	Bayview Heights Reservoir Zone	0.500
Cabrillo Tank	Alamo Reservoir Zone	0.045
Bayview Tank	Bayview Heights Reservoir Zone (pumped to Bayview Booster Zone and Calle Cordoniz Reservoir Zone)	0.220
Calle Cordoniz Tank	Calle Cordoniz Reservoir Zone	0.250
Alamo Tank	Alamo Reservoir Zone	0.084
Total storage capacity		**1.099**

5.3.4 Existing System Supply and Capacity Analysis

This analysis of the existing water distribution system evaluated the nine pressure zones separately and then the system as a whole to verify that adequate supply and storage facilities were available. The analysis reviewed the demand periods (ADD, MDD, PHD, MDD+FF); the duration for each demand period is detailed in TABLE 5-1. The duration of MDD+FF was established by the fire-flow criteria identified in TABLE 5-3.

In the following subsections, an analysis is performed for each pressure zone and for the overall system. The demands and production capacities for each zone are presented in a table that summarizes the results. These tables present the demands for each demand period in the zone and for any zones that depend on this zone for supplies. These demands are presented as a flow rate and are converted into a demand volume using the duration for the demand period. For example, a demand of 100 gpm for ADD would be equal to a demand volume of 144,000 gallons, given that the duration of ADD is 24 hours.

Available supplies are presented below the demand volume totals. Available supplies include water supply sources, booster pumping capacity, and stored water. Stored water was not used to provide water supplies during ADD or MDD. Stored water that was allocated as operational storage was assumed to be available for PHD, and water stored for fire flows was assumed to be available for MDD+FF. The total supplies were assumed to be available for ADD and MDD+FF. For the purpose of assuring reliable water service is provided to customers, each zone's ability to meet MDD and PHD with firm capacity was analyzed. (Firm capacity was defined as the available capacity with the largest pumping unit out of service.) The available production was calculated by converting flow rates into a production volume (using the duration of the demand period) and adding the available storage volume.

The last two lines of the table compare the system's available production capacity to the demands for the same duration. Where production capacity exceeds demands, the row *supply minus demand* will be positive. This indicates an adequate combination of supplies and storage. Where this occurs, the last row of the table, *supply meets demand*, will contain *yes*. However, if demands exceed production, then the row *supply minus demand* will have a negative value, and the row *supply meets demand* will contain *no*. In this latter case, proposed improvements were evaluated to correct the deficiency.

Alamo Reservoir Zone Analysis

Water supply to the Alamo Reservoir Zone is provided by three boosters from Cabrillo Well #1, as listed in TABLE 2-7. There is 0.129 MG storage in this pressure zone from the Alamo Reservoir and Cabrillo Reservoir. The Cabrillo Reservoir is in the Bayview Heights Reservoir Zone but serves the Alamo Reservoir Zone through the three Cabrillo boosters. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09 MG) was assumed.

The overall capacity analysis for the Alamo Reservoir Zone is presented in TABLE 5-7.

TABLE 5-7 Existing System Supply and Capacity Analysis—Alamo Reservoir Zone

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Alamo Res Zone		11	0.016	23	0.033	34	0.008	773	0.093
Upper Rodman Zone	PRV	9	0.013	19	0.028	29	0.007	19	0.002
Middle Rodman Zone	PRV	25	0.035	51	0.073	77	0.018	51	0.006
Total Demand		**45**	**0.065**	**93**	**0.134**	**140**	**0.033**	**843**	**0.101**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	1,000	45	0.065	93	0.134	140	0.033	627	0.075
PRVs/CVs	N/A	-	-	-	-	-	-	-	-
Reservoirs	0.084	-	-	-	-	0	0.000	216	0.026
Total Supply		**45**	**0.065**	**93**	**0.134**	**140**	**0.033**	**843**	**0.101**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Upper Rodman Zone Analysis

Water supply to the Upper Rodman Zone is provided by one PRV from the Alamo Reservoir Zone and one check valve from the Middle Rodman Zone, as listed in TABLE 2-8. There is no storage in this pressure zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09MG) was assumed.

The overall capacity analysis for the Upper Rodman Zone is presented in TABLE 5-8.

TABLE 5-8 Existing System Supply and Capacity Analysis—Upper Rodman Zone

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Upper Rodman Zone		9	0.013	19	0.028	29	0.007	769	0.092
Total Demand		**9**	**0.013**	**19**	**0.028**	**29**	**0.007**	**769**	**0.092**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	N/A	-	-	-	-	-	-	-	-
PRVs/CVs	1,830	9	0.013	19	0.028	29	0.007	769	0.092
Reservoirs	N/A	-	-	-	-	-	-	-	-
Total Supply		**9**	**0.013**	**19**	**0.028**	**29**	**0.007**	**769**	**0.092**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Middle Rodman Zone Analysis

Water supply to the Middle Rodman Zone is provided by one PRV from the Alamo Reservoir Zone, as listed in TABLE 2-8. There is no storage in this pressure zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09 MG) was assumed.

The overall capacity analysis for the Middle Rodman Zone is presented in TABLE 5-9.

TABLE 5-9 Existing System Supply and Capacity Analysis—Middle Rodman Zone

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Middle Rodman Zone		10	0.015	21	0.031	32	0.008	771	0.093
Lower Rodman Zone	PRV	14	0.021	30	0.043	44	0.011	30	0.004
Upper Rodman Zone	CV	0	0.000	0	0.000	0	0.000	0	0.000
Total Demand		**25**	**0.035**	**51**	**0.073**	**77**	**0.018**	**801**	**0.096**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	N/A	-	-	-	-	-	-	-	-
PRVs/CVs[a]	1,565	25	0.035	51	0.073	77	0.018	801	0.096
Reservoirs	N/A	-	-	-	-	-	-	-	-
Total Supply		**25**	**0.035**	**51**	**0.073**	**77**	**0.018**	**801**	**0.096**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

[a] The single PRV serving this zone has been assumed to be available for all demand scenarios in this analysis. However, when maintenance is performed on this PRV, it must be taken out of service and there is no supply to the zone. A project has been defined in this Master Plan (project 1.10.0, Table 8-2) to replace the check valve on Travis Drive with a dual-flow PRV in order to provide a second source of supply (i.e. firm capacity) to this zone.

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Lower Rodman Zone Analysis

Water supply to the Lower Rodman Zone is provided by one PRV from the Middle Rodman Zone, as listed in TABLE 2-8. There is no storage in this pressure zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.12 MG) was assumed.

The overall capacity analysis for the Lower Rodman Zone is presented in TABLE 5-10.

TABLE 5-10 Existing System Supply and Capacity Analysis—Lower Rodman Zone

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Lower Rodman Zone		14	0.021	30	0.043	44	0.011	1,030	0.124
Bayview Heights Zone	PRV	0	0.000	0	0.000	0	0.000	0	0.000
Total Demand		**14**	**0.021**	**30**	**0.043**	**44**	**0.011**	**1,030**	**0.124**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	N/A	-	-	-	-	-	-	-	-
PRVs	1,565	14	0.021	30	0.043	44	0.011	1,030	0.124
Reservoirs	N/A	-	-	-	-	-	-	-	-
Total Supply		**14**	**0.021**	**30**	**0.043**	**44**	**0.011**	**1,030**	**0.124**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Bayview Booster Zone Analysis

Water supply to the Bayview Booster Zone is provided by one check valve from the Calle Cordoniz Reservoir Zone and two boosters from the Bayview Reservoir in the Bayview Heights Reservoir Zone, as listed in TABLE 2-7. There is no storage in this pressure zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09 MG) was assumed.

The overall capacity analysis for the Bayview Booster Zone is presented in TABLE 5-11.

TABLE 5-11 Existing System Supply and Capacity Analysis—Bayview Booster Zone

	Planning Scenario			
	ADD	**MDD**	**PHD**	**MDD+FF**
Duration (Hours)	24	24	4	2

Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Bayview Booster Zone		18	0.026	38	0.055	57	0.014	788	0.095
Total Demand		**18**	**0.026**	**38**	**0.055**	**57**	**0.014**	**788**	**0.095**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	164	18	0.026	38	0.055	57	0.014	164	0.020
CV	1,750	0	0.000	0	0.000	0	0.000	624	0.075
Reservoirs	N/A	-	-	-	-	-	-	-	-
Total Supply		**18**	**0.026**	**38**	**0.055**	**57**	**0.014**	**788**	**0.095**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Calle Cordoniz Reservoir Zone Analysis

Water supply to the Calle Cordoniz Reservoir Zone is provided by one check valve from the Bayview Heights Reservoir Zone and two boosters from the Bayview Reservoirs, as listed in TABLE 2-7. There is 0.25 MG storage in this pressure zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09 MG) was assumed.

The overall capacity analysis for the Calle Cordoniz Reservoir Zone is presented in TABLE 5-12.

TABLE 5-12 Existing System Supply and Capacity Analysis—Calle Cordoniz Reservoir Zone

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Calle Cordoniz Zone		37	0.053	76	0.110	114	0.027	826	0.099
Bayview Heights Zone	PRV	0	0.000	0	0.000	0	0.000	0	0.000
Sea Oak Zone	PRV	23	0.033	48	0.069	72	0.017	48	0.006
Highland Zone	PRV	14	0.020	28	0.040	42	0.010	28	0.003
Bayview Booster Zone	CV	0	0.000	0	0.000	0	0.000	0	0.000
Total Demand		**73**	**0.106**	**152**	**0.219**	**228**	**0.055**	**902**	**0.108**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	1,000	73	0.106	152	0.219	228	0.055	902	0.108
PRVs	1,750	0	0.000	0	0.000	0	0.000	0	0.000
Reservoirs	0.25	-	-	-	-	0	0.000	0	0.000
Total Supply		**73**	**0.106**	**152**	**0.219**	**228**	**0.055**	**902**	**0.108**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Highland Zone Analysis

Water supply to the Highland Zone is provided by one check valve from the Bayview Heights Reservoir Zone and one PRV from the Calle Cordoniz Zone, as listed in TABLE 2-8. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09 MG) was assumed.

The overall capacity analysis for the Highland Zone is presented in TABLE 5-13.

TABLE 5-13 Existing System Supply and Capacity Analysis—Highland Zone

		Planning Scenario							
		ADD		MDD		PHD		MDD+FF	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Highland Zone		14	0.020	28	0.040	42	0.010	778	0.093
Bayview Heights Zone	PRV	0	0.000	0	0.000	0	0.000	0	0.000
Total Demand		**14**	**0.020**	**28**	**0.040**	**42**	**0.010**	**778**	**0.093**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	N/A	-	-	-	-	-	-	-	-
PRVs	2,515	14	0.020	28	0.040	42	0.010	778	0.093
Reservoirs	N/A	-	-	-	-	-	-	-	-
Total Supply		**14**	**0.020**	**28**	**0.040**	**42**	**0.010**	**778**	**0.093**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Sea Oak Zone Analysis

Water supply to the Sea Oak Zone is provided by one PRV from the Calle Cordoniz Reservoir Zone and a check valve from the Bayview Heights Reservoir Zone, as listed in TABLE 2-8. There is no storage in this pressure zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09 MG) was assumed.

The overall capacity analysis for the Sea Oak Zone is presented in TABLE 5-14.

TABLE 5-14 Existing System Supply and Capacity Analysis—Sea Oak Zone

		Planning Scenario							
		ADD		MDD		PHD		MDD+FF	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Sea Oak Zone		23	0.033	48	0.069	72	0.017	798	0.096
Total Demand		**23**	**0.033**	**48**	**0.069**	**72**	**0.017**	**798**	**0.096**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	N/A	-	-	-	-	-	-	-	-
PRVs	2,550	23	0.033	48	0.069	72	0.017	798	0.096
Reservoirs	N/A	-	-	-	-	-	-	-	-

Total Supply	**23**	**0.033**	**48**	**0.069**	**72**	**0.017**	**798**	**0.096**
Supply Minus Demand	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand	**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Bayview Heights Reservoir Zone Analysis

Water supply to the Bayview Heights Reservoir Zone is provided by five active wells (Los Olivos #3 and #5 flow through the Los Olivos Boosters; in addition, Cabrillo Well #1 can pump directly into the Bayview Heights Reservoir Zone), one PRV from the Highland Zone, two PRVs from the Calle Cordoniz Reservoir Zone, and one PRV from the Lower Rodman Zone, as listed in TABLE 2-8. Rosina Well #1 is the largest source of capacity for the Los Osos System, so it was assumed to be unavailable for firm capacity. There is 0.765 MG storage in this pressure zone, however 0.045 MG of the storage is allocated to the Alamo Reservoir Zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.27 MG) was assumed.

The overall capacity analysis for the Bayview Heights Reservoir Zone is presented in TABLE 5-15.

TABLE 5-15 Existing System Supply and Capacity Analysis—Bayview Heights Reservoir Zone

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		3	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Bayview Heights Zone		198	0.285	410	0.591	616	0.148	1,910	0.344
Alamo Res Zone	Booster	45	0.065	93	0.134	140	0.033	93	0.017
Bayview Booster	Booster	18	0.026	38	0.055	57	0.014	38	0.007
Calle Cordoniz Zone	Booster	73	0.106	152	0.219	228	0.055	152	0.027
Cuesta Zone	PRV	52	0.075	108	0.155	162	0.039	108	0.019
Sea Oak Zone	CV	0	0.000	0	0.000	0	0.000	0	0.000
Highland Zone	CV	0	0.000	0	0.000	0	0.000	0	0.000
Total Demand		**387**	**0.557**	**801**	**1.154**	**1,202**	**0.288**	**2,301**	**0.414**
Supply	Capacity								
Wells	1,035	1,035	1.490	650	0.936	650	0.156	1,035	0.186
Boosters	800	300	0.432	300	0.432	347	0.083	516	0.093
PRVs	3,360	0	0.000	0	0.000	0	0.000	0	0.000
Reservoirs	0.22	-	-	-	-	205	0.049	750	0.135
Total Supply		**1,335**	**1.922**	**950**	**1.368**	**1,202**	**0.288**	**2,301**	**0.414**
Supply Minus Demand		**948**	**1.365**	**149**	**0.214**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Cuesta Zone Analysis

Water supply to the Cuesta Zone is provided by four PRVs from the Bayview Heights Reservoir Zone, as listed in TABLE 2-8. There is no storage in this pressure zone. Fire flow was assumed to occur at only one place at a given time, and the maximum fire flow (0.09 MG) was assumed.

The overall capacity analysis for the Cuesta Zone is presented in TABLE 5-16.

TABLE 5-16 Existing System Supply and Capacity Analysis—Cuesta Zone

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		2	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Cuesta Zone		52	0.075	108	0.155	162	0.039	858	0.103
Total Demand		**52**	**0.075**	**108**	**0.155**	**162**	**0.039**	**858**	**0.103**
Supply	Capacity								
Wells	N/A	-	-	-	-	-	-	-	-
Boosters	N/A	-	-	-	-	-	-	-	-
PRVs	1,970	52	0.075	108	0.155	162	0.039	858	0.103
Reservoirs	N/A	-	-	-	-	-	-	-	-
Total Supply		**52**	**0.075**	**108**	**0.155**	**162**	**0.039**	**858**	**0.103**
Supply Minus Demand		**0**	**0.000**	**0**	**0.000**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The existing system supply and storage capacity analysis results indicate that facilities in this pressure zone are adequate to meet the demands for all planning scenarios.

Systemwide Capacity Analysis

In the systemwide analysis, all supply and storage facilities were included. The total existing demands were presented in TABLE 5-4. The total production capacity in TABLE 5-5 and the storage facilities in TABLE 5-6 were used for the appropriate demand periods. The fire flow used for MDD+FF was based on the largest fire flow in the system, a 1,500-gpm fire flow for 3-hour duration.

The results of the systemwide supply and storage analysis for the existing system are summarized in TABLE 5-17.

TABLE 5-17 Existing System Supply and Capacity Analysis—Systemwide

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		3	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Total Demand		**387**	**0.557**	**801**	**1.154**	**1,202**	**0.288**	**2,301**	**0.414**
Supply	Capacity								
Wells	1,335	1,035	1.490	650	0.936	650	0.156	1,035	0.186
Boosters	2,964	300	0.432	300	0.432	400	0.096	300	0.054
Reservoirs	1.099	-	-	-	-	152	0.036	966	0.174

Total Supply	**1,335**	**1.922**	**950**	**1.368**	**1,202**	**0.288**	**2,301**	**0.414**
Supply Minus Demand	**948**	**1.365**	**149**	**0.214**	**0**	**0.000**	**0**	**0.000**
Supply Meets Demand	**YES**		**YES**		**YES**		**YES**	

The systemwide supply and storage analysis results for the existing system indicate that the existing supply meets the demands for all planning scenarios.

5.3.5 Existing System Storage Analysis

The analysis of the existing storage facilities evaluated the required storage for each pressure zone and compared it to the existing storage available for each zone to determine the storage deficiencies. The benefits of storage and the types of storage (operational, fire, and emergency) are described in more detail in section 5.2.2.

TABLE 5-18 evaluates the three types of storage to calculate the total required storage for each zone and the entire system. The operational storage is calculated by subtracting the MDD from the PHD to obtain the additional flowrate that is required during the PHD scenario. This additional flowrate is multiplied by the duration of PHD and then converted to a volume to determine the required operational storage. A duration of four hours was used to account for the typical duration of peak demands during the day. The fire storage for each zone is based on criteria given in section 5.2.2. In cases where two or more pressure zones retain their fire storage in the same reservoir, that reservoir only needs to contain the fire storage for the zone with the largest recommended fire storage volume. This is because the criteria consider only one fire flow can occur in the system at any given time. To prevent accounting for excess fire storage, pressure zones were given a fire storage total of 0 MG in TABLE 5-18 when fire storage of larger or equal size was used in another zone that retains its fire storage in the same tank. The emergency storage is the volumetric measurement of the ADD over a duration of 12 hours.

Storage deficiencies are identified for each zone in TABLE 5-19. All tanks in the existing system are listed in the left column of the table. All pressure zones in the existing system are listed in the top row of the table. The numbers in the table represent the allotted amount of storage, in millions of gallons, for each zone from each tank. A dash in the table denotes storage from that tank is unavailable for that zone. Zones that are able to utilize storage in a tank, but are not allotted any storage from it are shown in the table as zero. Summing the numbers across the rows results in the total storage volume of the tank listed in the left column of that row. Summing the numbers going down the columns results in the available storage for the zone listed in the top row of that column. The required storage, taken from TABLE 5-18, is given in the row below the available storage. Subtracting the required storage from the available storage within a column results in the excess storage for that column's zone. Negative numbers imply a storage deficiency and are given a "NO" in the adequate storage column. A "YES" in the adequate storage column implies there is adequate storage available for that zone. Fire storage is calculated to supplement supply when the supply is less than the current demand plus fire flow (see Section 5.3.4). Fire storage requirements are planning standards and fire storage is typically only required in times of high demands, supply limitations, and/or emergencies.

TABLE 5-18 Existing System Storage Analysis – Calculated Storage

	Zones										
	Alamo Reservoir	Upper Rodman	Middle Rodman	Lower Rodman	Bayview Booster	Calle Cordoniz	Sea Oak	Highland	Bayview Heights	Cuesta	Systemwide
Operational											
PHD	34	29	32	44	57	114	72	42	616	162	1,202
MDD	23	19	21	30	38	76	48	28	410	108	801
PHD minus MDD	11	10	11	15	19	38	24	14	205	54	401
Duration	4	4	4	4	4	4	4	4	4	4	4
MG	0.003	0.002	0.003	0.004	0.005	0.009	0.006	0.003	0.049	0.013	0.096
Fire											
GPM	750	750	750	1,000	750	750	750	750	1,500	750	-
Duration	2	2	2	2	3	2	2	2	3	2	-
MG*	0.000	0.000	0.000	0.120	0.000	0.090	0.000	0.000	0.270	0.000	0.480
Emergency											
ADD	11	9	10	14	18	37	23	14	198	52	387
Duration	12	12	12	12	12	12	12	12	12	12	12
MG	0.008	0.007	0.007	0.010	0.013	0.026	0.017	0.010	0.143	0.038	0.279
Total Recommended Storage	**0.011**	**0.009**	**0.010**	**0.134**	**0.018**	**0.126**	**0.022**	**0.013**	**0.462**	**0.050**	**0.850**

* A fire storage total of zero indicates that fire storage of larger or equal size was used in another zone that receives its fire storage from the same tank.
NOTE: All demand period scenarios (ADD, MDD, and PHD) are given in gallons per minute (GPM). All durations are given in hours. The rows titled "MG" and the total required storage are given in million gallons (MG)

TABLE 5-19 Existing System Storage Analysis - Adequacy Evaluation

	Zones										
	Alamo Reservoir	Upper Rodman	Middle Rodman	Lower Rodman	Bayview Booster	Calle Cordoniz	Sea Oak	Highland	Bayview Heights	Cuesta	Total
Alamo Reservoir	0.011	0.009	0.010	0.054	-	-	-	-	-	-	0.084
Cabrillo Reservoir	-	-	-	0.045	-	-	-	-	-	-	0.045
Bayview Heights Reservoir	-	-	-	-	-	-	-	-	0.170	0.050	0.220
Calle Cordoniz Reservoir	-	-	-	-	0.018	0.197	0.022	0.013	-	-	0.250
Los Olivos Reservoir	-	-	-	-	-	-	-		0.500	-	0.500
Available Storage	0.011	0.009	0.010	0.099	0.018	0.197	0.022	0.013	0.670	0.050	1.099
Recommended Storage*	0.011	0.009	0.010	0.134	0.018	0.126	0.022	0.013	0.462	0.050	0.850
Available Minus Recommended	0.000	0.000	0.000	(0.035)	0.000	0.071	0.000	0.000	0.208	0.000	0.249
Adequate Storage	**YES**	**YES**	**YES**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

* Recommended Storage numbers are from Table 5-18
NOTE: All numbers given are in million gallons (MG)

The existing system storage analysis results indicate no overall storage deficiency; the overall available storage capacity meets the required storage for the Los Osos System, and excess water can flow by gravity from the reservoirs in higher pressure zones to overcome storage deficiencies in the lower pressure zones. However, as storage capacities from the Alamo and Cabrillo Reservoirs are used to meet the storage needs of the Alamo Reservoir Zone along with the Upper Rodman, Middle Rodman and Lower Rodman Zones, the existing system storage analysis results indicate a 0.035 MG storage deficiency in the Alamo Reservoir Zone area (including Upper, Middle and Lower Rodman Zones). Proposed improvements to overcome this storage deficiency are described in Section 5.3.6.

5.3.6 Proposed Improvements to Address Deficiencies in the Existing System

Various alternatives were considered while investigating improvements to correct the deficiencies identified in the supply and storage evaluation; these are listed in TABLE 5-20. Deficiencies may be corrected by adding supply, storage, or a combination of both. In these cases, the deficiency is shown in both supply (gpm) and storage (MG). The descriptions of the deficiency alternatives are given at the end of TABLE 5-20.

The deficiencies identified in the supply and storage evaluation were a storage deficiency of 0.035 MG in the Alamo Reservoir Zone area, calculated using the criteria defined in TABLE 5-2.

The numbering system used in TABLE 5-20 is a series of three numbers. The first number indicates the planning period: 1 for the existing system and 2 for the 2040 system. The second number indicates the deficiency number, which starts at 1 and increments by 1 for each deficiency identified. The third number identifies the improvement alternative, but zero is reserved for the deficiency. Therefore, the alternative number 1.2.3 would be used to identify the third proposed alternative for the second deficiency in the existing system.

TABLE 5-20 Existing System Proposed Supply and Storage Improvements

Deficiency/ Alternative Number	Deficiency/Alternative Description	Pressure Zone	Supply Capacity (gpm)	Storage Capacity (MG)
1.1.0	**Inadequate Storage**	**Alamo Reservoir Zone area** (including Upper, Middle and Lower Rodman Zones)		0.035
1.1.1	Increase storage capacity	Alamo Reservoir Zone		0.035

Descriptions of Deficiency Alternatives

Deficiency No. 1.1.0

Alternative No. 1.1.1

This alternative proposes to increase the storage capacity in the Alamo Reservoir Zone by 0.035 MG. (A project for replacement of the Alamo Reservoir is currently under design; increasing the capacity from 0.084 MG to at least 0.119 MG would resolve this deficiency.)

5.3.7 Recommended Improvements to Address Deficiencies in the Existing System

Recommended improvements to resolve the deficiencies in the existing system are given in TABLE 5-21. These proposed improvements were recommended for their ability to correct the deficiency and be cost-effective compared to competing alternatives. Refer to the

'Descriptions of Deficiency Alternatives' in section 5.3.6 for more detailed descriptions of proposed improvements. In some cases, the capacity of the proposed improvement is larger than described in the 'Descriptions of Deficiency Alternatives'. This was necessary in order to resolve multiple deficiencies.

TABLE 5-21 Existing System Recommended Supply and Storage Improvements

Alternative Number	Alternative Description	Deficiencies Resolved	Supply/Storage Capacity
1.1.1	Increase capacity of Alamo Reservoir	1.1.0	0.035 MG

5.4 2040 System Evaluation

Analysis of the water system for the year 2040 was performed to identify long-term improvements needed for the water system at buildout. This analysis included the following assumptions:

- Existing supply sources would remain active or be replaced in kind.
- Planned improvements to address existing system deficiencies plus the post-2015 improvements are operational.
- The demands developed in Section 3, Existing and Future Water Demands, were assumed for the respective demand periods.

5.4.1 2040 System Water Demands for Each Demand Period

TABLE 5-22 defines the 2040 demands for the Los Osos System. The demands are not provided for each pressure zone because it is unknown how much each zone's demands will increase by the year 2040.

TABLE 5-22 2040 System Water Demands

	ADD (gpm)	MDD (gpm)	PHD (gpm)
Systemwide	387	561	842

5.4.2 2040 System Supply Facilities

The supply facilities for the 2040 system include all supply facilities in the existing system along with all recommended supply facilities to resolve the existing system's deficiencies. TABLE 5-23 summarizes the supply for the 2040 System.

TABLE 5-23 2040 System Assumed Supply Facilities

Facility Name	Total Capacity (gpm)
Additional facilities in the 2040 System	0
Existing supply – Wells	1,335

Facility Name	Total Capacity (gpm)
Total production capacity for 2040	**1,335**

5.4.3 2040 System Storage Facilities

The storage facilities for the 2040 system include all storage facilities in the existing system along with all recommended storage facilities to resolve the existing system's deficiencies. TABLE 5-24 summarizes the storage for the 2040 System.

TABLE 5-24 2040 System Assumed Storage Facilities

Facility Name	Primary Pressure Zone Served	Total Capacity (MG)
Recommended storage facilities	N/A	0.035
Existing storage	Systemwide	1.099
Total storage capacity		**1.134**

5.4.4 2040 System Capacity Analysis

The supply analysis for the 2040 system uses the 2040 projected demands and includes the recommended 2040 supply improvements to analyze system deficiencies. An analysis is not given for each pressure zone because it is unknown how much each zone's demands will increase by year 2040. The supply analysis is given in TABLE 5-25.

TABLE 5-25 2040 System Supply and Capacity Analysis—Systemwide

		Planning Scenario							
		ADD		**MDD**		**PHD**		**MDD+FF**	
Duration (Hours)		24		24		4		3	
Demand		GPM	MG	GPM	MG	GPM	MG	GPM	MG
Total Demand		**387**	**0.557**	**561**	**0.808**	**842**	**0.202**	**2,061**	**0.371**
Supply	Capacity								
Wells	1,335	1,335	1.922	950	1.368	950	0.228	1,335	0.240
Reservoirs	1.134	-	-	-	-	281	0.067	1,500	0.270
Total Supply		**1,335**	**1.922**	**950**	**1.368**	**1,231**	**0.295**	**2,835**	**0.510**
Supply Minus Demand		**948**	**1.365**	**389**	**0.560**	**389**	**0.093**	**774**	**0.139**
Supply Meets Demand		**YES**		**YES**		**YES**		**YES**	

The systemwide supply and storage analysis results for the 2040 system indicate that the supply meets the demands for all planning scenarios.

5.4.5 2040 System Storage Analysis

The storage analysis for the 2040 system uses the 2040 projected demands and includes the recommended supply and storage improvements for the existing system to analyze system deficiencies. Like the 2040 supply analysis, each pressure zone is not analyzed because it is unknown how much each zone's demands will increase by year 2040. The storage analysis is given in TABLE 5-26.

TABLE 5-26 2040 System Storage Analysis

Scenario		Systemwide
Operational	PHD	842
	MDD	561
	PHD minus MDD	281
	Duration	4
	MG	0.067
Fire	GPM	1,500
	Duration	3
	MG*	0.270
Emergency	ADD	387
	Duration	12
	MG	0.279
Total Recommended Storage		0.616
Available Storage in 2040		1.134
Available minus Recommended		0.518
Adequate Storage		YES

The 2040 system storage analysis results indicate no deficiency.

5.4.6 Proposed Improvements to Address Deficiencies in the 2040 System

The 2040 system analysis results indicate no deficiencies.

TABLE 5-27 2040 System Proposed Supply and Storage Improvements

Deficiency/ Alternative Number	Deficiency/Alternative Description	Pressure Zone	Supply Capacity (gpm)	Storage Capacity (MG)
-	-	-	-	-

5.4.7 Recommended Improvements to Address Deficiencies in the 2040 System

No deficiencies were identified for the 2040 system, as shown in TABLE 5-28.

TABLE 5-28 2040 System Recommended Supply and Storage Improvements

Alternative Number	Alternative Description	Deficiencies Resolved	Supply/Storage Capacity
-	-	-	-

5.5 Summary of Proposed Supply and Storage Improvements through 2040

According to the supply and capacity analysis results in this Master Plan, the following additional supply is necessary to meet future demands:

- Existing system: no additional supply
- 2040 system: no additional supply

According to the storage analysis results in this Master Plan, the following additional storage is necessary to meet future demands:

- Existing system: 0.035 MG of additional storage capacity in the Alamo Reservoir Zone
- 2040 system: no additional storage

The supply and storage improvements planned by GSWC and analyzed in these evaluations are further examined in Section 6, Hydraulic Analysis and Evaluation. The hydraulic analysis helps determine the optimal configuration of improvements to provide maximum operational and cost benefit, and any resulting recommended improvements are incorporated into the CIP.

SECTION 6

Hydraulic Analysis and Evaluation

This section documents the hydraulic analysis and evaluation results for the Los Osos System. The hydraulic analysis used the calibrated computer model to evaluate the existing water system. This analysis and evaluation accomplished the following tasks:

- Summarized the criteria for the hydraulic analysis
- Performed simulations for various demand conditions and demand periods
- Analyzed the modeling results to identify deficiencies
- Analyzed various proposed improvements to investigate ways to mitigate these deficiencies
- Developed a list of recommended improvements that provide a cost-effective means to correct deficiencies

In following sections, the hydraulic analysis results of the existing water system were compared with the objectives identified in the technical memorandum titled *Master Planning Criteria and Standards* (see Appendices). When the analysis indicated that the system did not meet these criteria, a deficiency was identified and improvements were proposed to mitigate the deficiency.

6.1 Overview

Hydraulic analyses of networked water distribution systems are most efficiently performed with the aid of hydraulic computer models and specialized software that perform the numerical analysis. The hydraulic computer model assists with measuring system performance, analyzing operational improvements, and developing a systematic method of determining the size and timing required for new facilities. The model can be used to analyze existing water systems, future water systems, and the effect of specific improvements. By analyzing numerous planning scenarios relatively quickly and easily, the model provides answers to several "what if" questions. The computer program analyzes all of the information in the system data file and generates results in terms of pressures, flow rates, and operating status. The key to successfully using the computer model is correct interpretation of these results, and understanding how the water distribution system was affected.

6.2 Analysis Approach

This hydraulic analysis examined the Los Osos System for only one planning period:

- **Existing (2019) system.** The existing water system analyses assumed 2019 demands, as described in Section 3, and facilities that were operational in 2019.

The demands used in this hydraulic analysis are the same as used for the supply and storage capacity analysis in Section 5.

6.2.1 System Performance Criteria

Hydraulic analysis of the water system involved the use of a computer model that was developed specifically for the Los Osos System and calibrated to conditions observed in the field (see Section 4, Hydraulic Model Development and Calibration). This computer model was used to identify hydraulic deficiencies under the existing planning scenario. Hydraulic model simulations were developed to analyze demand periods (ADD, MDD, PHD, and MDD+FF) to determine whether the system could meet the performance objectives identified for this master plan. These criteria are summarized in TABLE 6-1.

TABLE 6-1 Hydraulic Analysis Criteria

Demand Period	Pipeline Criteria[a]	Pressure Criteria[b]
ADD	Velocity less than 5 fps and head loss less than 6 ft per 1,000 ft	Greater than 40 psi and less than 125 psi
MDD	Velocity less than 5 fps and head loss less than 6 ft per 1,000 ft	Greater than 40 psi and less than 125 psi
PHD	Velocity less than 10 fps	Greater than 30 psi and less than 125 psi
MDD + fire flow	Velocity less than 10 fps	Greater than 20 psi

[a] If velocity or headloss in a pipeline exceeded the criteria listed but did not result in low pressures in the system, the pipeline was not recommended for replacement due to hydraulic deficiencies alone.
[b] Pressure criteria apply only at service connections.

6.2.2 Fire-flow Requirements

In addition to providing adequate water supply and pressure to serve residential, commercial, and industrial water demands placed on the system, the water system must also deliver an adequate supply for firefighting. Since fires can occur at any time, the water system must be ready to provide the required flow at all times with an adequate residual pressure. The water system should be capable of providing the fire flows during an MDD period (MDD+FF), which represents the day of the year having the highest water demands.

To determine the system's capacity to provide adequate fire flows, it was necessary to establish minimum fire-flow demand requirements to be applied to various locations throughout the distribution system, as well as a minimum residual pressure (the pressure near the flowing hydrant) and system pressure. The local agency responsible for establishing fire-flow requirements for the Los Osos System service area is CDF/Cal Fire, which provides fire protection services for the unincorporated areas of San Luis Obispo County. Their fire code regulations were used as a guide to develop the fire-flow criteria established for this master plan, which were presented in the previous section in Table 5-3.

6.3 Existing System Hydraulic Analysis

Several hydraulic computer model simulations were conducted for the existing distribution system to identify system and operational deficiencies, and to evaluate system improvements to mitigate these deficiencies. If more than one alternative was possible to mitigate a deficiency, the most cost-effective and constructible improvement was recommended.

6.3.1 Operational Assumptions

GSWC operations staff provided information on how the Los Osos System would normally be operated under ADD, MDD, and PHD periods. Based on this information, the facilities available for the hydraulic analysis of the existing system are presented in TABLE 6-2. (Note: The status of wells, booster pumps and storage tanks were not based on the model results, but on the amount of supply needed for each demand period. For ADD, there is flexibility to operate various combinations of wells, as not all of the wells need to be operational to achieve the desired pressures; for MDD and PHD scenarios, firm capacity must be used.)

TABLE 6-2 Existing System Operating Facility Status

Facility Name	ADD	MDD	PHD
Wells—Main Zone			
South Bay Well #1	Available	On	On
Los Olivos Well #3	Available	On	On
Rosina Well #1	Available	Off	Off
Skyline Well #1	Available	On	On
Cabrillo Well #1	Off	Off	Off
Booster pumps			
Bayview A	Available	On	On
Bayview B	Available	Off	Off
Bayview C	Available	Off	Off
Bayview D	Available	On	On
Cabrillo A	Available	Off	Off
Cabrillo B	Available	On	On
Cabrillo C	Available	Off	Off
Los Olivos A	Available	Off	Off
Los Olivos B	Available	On	On
Storage tanks			
Alamo	75%	75%	75%
Bayview	75%	75%	75%
Cabrillo	75%	75%	75%
Calle Cordoniz	75%	75%	75%
Los Olivos	75%	75%	75%

6.3.2 Average Day Scenario Analysis

To analyze the average day scenario for the existing system, simulations were performed using the computer model with ADD. The demands were distributed in the model per TABLE 5-4, for a total demand of approximately 387 gpm. Only the facilities listed as 'Available' in TABLE 6-2 were used for ADD. (Note: Storage should not be drawn down for this planning scenario.) The modeling results were compared to the criteria identified in TABLE 6-1, and are discussed in Subsection 6.3.6.

6.3.3 Maximum Day Scenario Analysis

To analyze the maximum day scenario for the existing system, simulations were performed using the computer model with MDD. The demands were distributed in the model per TABLE 5-4, for a total demand of approximately 801 gpm. Only the facilities listed as 'On' in TABLE 6-2 were used for MDD. (Note: Storage should not be drawn down for this planning scenario.) The modeling results were compared to the criteria identified in TABLE 6-1, and are discussed in Subsection 6.3.6.

6.3.4 Peak Hour Scenario Analysis

To analyze the peak hour scenario for the existing system, simulations were performed using the computer model with PHD. The demands were distributed in the model per TABLE 5-4, for a total demand of approximately 1,202 gpm. Only the facilities listed as 'On' in TABLE 6-2 were used for PHD. (Note: Storage may be drawn down for this planning scenario.) The modeling results were compared to the criteria identified in TABLE 6-1, and are discussed in Subsection 6.3.6.

6.3.5 Fire-flow Scenario Analysis

For this master plan revision, the fire flow scenario was not analyzed.

6.3.6 Analysis Results and Recommended Improvements for the Existing System

Various alternatives were considered to correct the hydraulic deficiencies identified in the hydraulic analysis. The proposed improvements were evaluated for their ability to correct the deficiency and for their cost-effectiveness as compared to other alternatives.

Steady-State Deficiencies

The deficiencies identified in the ADD, MDD, and PHD simulations for the existing system are presented in TABLE 6-3 (Note: This table also includes any existing system improvements for supply and storage from Section 5). These deficiencies were analyzed in detail using the computer model by adding proposed improvements, reviewing the updated results, and repeating this process until acceptable results were obtained.

The distribution system was analyzed to identify areas of the system that experienced pressures below 40 psi or above 125 psi (criteria identified in TABLE 6-1). Various steady-state planning scenarios were used to analyze system pressures under different demand conditions to verify adequate system pressures. Where low pressures were observed during the analysis, one or more approaches were used to mitigate the low-pressure problem. In some cases, low pressures can be corrected with no physical improvement, such as by increasing the pressure setting of an upstream pressure regulating valve. However, sometimes substantial improvements may be required. Improvements may include replacing older pipelines with larger diameter pipelines to reduce friction losses, constructing new pump stations or pressure regulating stations, or modifying the boundaries of an existing pressure zone.

High velocities in water pipelines can also be an indication of an operational deficiency, and can lead to scouring of the pipe lining material or increase the chances of a valve failure. Increased velocities contribute to increased head loss, usually resulting in a less efficient water distribution system. Higher velocities may be acceptable for short-term operation, such as when needed for fire-flow, but otherwise should be lower where practical. The planning scenarios used to analyze the Los Osos System for pressure deficiencies were also used to evaluate the velocities under the same demand periods (ADD, MDD, and PHD). The velocity criteria used to evaluate the distribution system for each demand period were defined in TABLE 6-1.

As stated in footnote ‘a’ of TABLE 6-1, “If velocity or headloss in a pipeline exceeded the criteria listed but did not result in low pressures in the system, the pipeline was not recommended for replacement.” Thus, pipelines with velocities above the criteria identified in TABLE 6-1 but below 10 fps were reviewed for excessive pressure loss resulting in low pressures or excessive energy use. Where the velocities did not appear to contribute to pressure problems or excessive pumping, then no deficiency was identified and no improvement was proposed.

The numbering system used in deficiency tables below is a series of three numbers. The first number indicates the planning period: 1 for the existing system and 2 for the 2035 system. The second number indicates the deficiency number, which starts at 1 and increases by 1 for each deficiency identified. The third number identifies the improvement alternative (zero is reserved for the deficiency identification). Proposed improvements to correct the deficiency are numbered starting at 1. Therefore, the alternative number 1.2.3 would be used to identify the third proposed alternative for the second deficiency in the existing system. (Note: Deficiencies identified may not start with the number 1.1.0 if there are deficiencies identified in a prior section of this master plan.)

TABLE 6-3 Existing System Deficiencies and Recommend Improvements for ADD, MDD, and PHD

Deficiency/ Alternative Number	Location	Deficiency	Recommended Improvement
1.2.0	**Bayview Heights Zone**	**MDD pressure**	
1.2.1	< 40 psi; Green Oaks Dr Area		Expand Calle Cordoniz Zone to include area between Green Oaks Dr and Bay Oaks Dr[a]
1.3.0	**Bayview Heights Zone**	**MDD headloss**	
1.3.1	6-inch AC, Los Osos Valley Rd between Palisades Dr and Tenth St		Upsize existing pipeline to 12-inch PVC to reduce hydraulic bottleneck
1.3.2	6-in AC, Bay Oaks Dr, Bayview Heights to Green Oaks and Winnell to Sunset		--

Deficiency/ Alternative Number	Location	Deficiency	Recommended Improvement
1.3.3	4-in AC, Anne Ave, Green Oaks to Bay Oaks		--
1.3.4	6-in AC, Bayview Heights Dr, Los Osos Valley to hydrant #47		--
1.4.0	**Cuesta Zone**	**MDD headloss**	
1.4.1	4-in AC, Pine Ave, n/o PRV to Ash St		--

[a] As of the publication date of this Master Plan, GSWC Operations staff have made system/valving modifications to expand the zone and resolve this issue.

Note: For those deficiencies that are not the result of low pressures in the system, pipelines will not be recommended for replacement due to hydraulic deficiencies alone. However, these pipelines may be recommended for replacement in Section 8 (System Condition Assessment), due to age and material of the main.

SECTION 7

Water Quality Evaluation

The purpose of this section is to provide documentation of GSWC's water quality assessment effort for the Los Osos System. Water quality of local groundwater and imported water were evaluated based on current federal and state standards and rules.

7.1 Current Status of Drinking Water Quality

The Los Osos System is supplied by six active wells: Skyline Well #1, Rosina Well #1, Cabrillo Well #1, Southbay Well #1, Los Olivos Well #3 and Los Olivos Well #5. The system has one emergency interconnection with Los Osos Community Services District (LOSCD).

Skyline Well #1 nitrate levels average 22 mg/L, which is well above the nitrate MCL of 10 mg/L (as N), and is treated through ion exchange at the Rosina Treatment Plant. Rosina Well #1 shows increasing influence of seawater intrusion resulting in high total dissolved solids (TDS) and chloride, ranging 800 – 1200 mg/L and 250 – 400 mg/L, respectively. TDS and chloride from Rosina Well #1 can be reduced through a blend with the ion exchange effluent, but this is generally not required because Rosina is not typically relied upon for normal supply. The chloride and TDS levels have went down in the Rosina Well since the ion exchange unit was brought online to treat Skyline. Rosina well was required to run with Skyline for blending before the ion exchange unit was installed in 2017, but it is now the last source to come on with the current operation of the system.

Los Olivos Well #3 is near, and occasionally over, the nitrate MCL. This well is blended with low nitrate water from Los Olivos Well #5 in the Los Olivos reservoir. Los Olivos Well #5 is <0.4 mg/L for nitrate and has no other contaminates of concern.

Cabrillo Well #1 occasionally exceeds the secondary maximum contaminate levels for both iron and manganese. Both iron and manganese are treated by oxidation and subsequent filtration. Cabrillo Well #1 averages about 5.9 mg/L (as N) for nitrate.

Southbay Well #1 has no contaminates of concern and has no current need for treatment.

At most well sites, 12.5 percent liquid sodium hypochlorite is injected to provide a disinfectant residual in the water entering the distribution system. At the Rosina ion exchange plant, sodium hypochlorite is injected after nitrate removal.

The drinking water quality of the Los Osos System must comply with the Safe Drinking Water Act (SDWA), which is composed of primary and secondary drinking water standards. Compliance with primary drinking water standards is regulated by the U.S. Environmental Protection Agency (EPA). Compliance with both primary and secondary standards is required by the State Water Resources Control Board Division of Drinking Water (DDW).

Water quality sampling is performed at the sources and within the distribution system to ensure compliance with regulatory standards. Sources are sampled as prescribed in Title 22 of the California Code of Regulations. Monitored constituents include general mineral, general physical, inorganic, volatile organic, synthetic organic, and radiological chemicals. The frequency of monitoring is dependent upon the parameter tested and the concentration of the constituent in the source water. Monitoring frequencies range from weekly to once every 9 years. The parameters monitored include specific constituents of concern (that is, if treatment is provided then the constituent being treated for would be tested), coliform bacteria, heterotrophic plate counts (HPCs), and chlorine residual. The distribution system is tested regularly for coliform bacteria, chlorine residual, general physical parameters, and disinfection by-products (trihalomethanes [TTHM] and haloacetic acids [HAA5]). The distribution system is tested weekly for the presence of coliform bacteria at representative locations throughout the system and general physical samples. Collection of disinfection by-product samples occurs on an annual basis.

7.2 Imported Water Quality

Los Osos does not import water, but there is one emergency interconnection with the Los Osos Community Services District.

7.3 Groundwater Quality

Water delivered to the Los Osos system complies with all primary and secondary MCLs; however, treatment is required. Skyline Well #1 is treated for high nitrate through Ion exchange, Los Olivos Well #3 is treated for high nitrate through blending with Los Olivos Well #5 and Cabrillo Well #1 is treated for iron and manganese by oxidation and subsequent filtration. Other compounds that may require treatment in some of these wells are, and TDS and chloride as they pertain to seawater intrusion.

7.4 Water Quality Evaluation

The following discussion provides information on the relevant water quality evaluation rules for the Los Osos System, including:

- Nitrate
- Seawater Intrusion, Total Dissolved Solids and Chloride
- Per- and Polyfluoroalkyl Substances

7.4.1 Nitrate

Los Olivos Well #3 is currently near or above the nitrate MCL. Treatment is achieved through blending with low nitrate water from Los Olivos Well #5 in the Los Olivos reservoir. Nitrate analyzers are in place to continuously monitor the water from the well and reservoir influent or effluent.

Skyline Well #1 has elevated levels of nitrate and is currently treated for removal of nitrates through an ion exchange unit at the Rosina Treatment Plant.

Cabrillo Well #1 is consistently over half the MCL of 10 mg/L (as N) in nitrate, and reached 8.4 mg/L (as N) in January 2018. The average level of nitrate in the Cabrillo Well between

2015 and 2019 was 5.9 mg/L (as N). Quarterly samples of Cabrillo well since January of 2018 have been consistently around 5.7 mg/L (as N) and have not exceeded 5.9 mg/L (as N).

7.4.2 Seawater Intrusion, Total Dissolved Solids and Chloride

In the Los Osos Groundwater Basin high TDS and chloride are generally associated with seawater intrusion into the lower aquifer. There are no requirements for systems that reach the TDS and chloride Upper Secondary MCL Ranges of 1,000 mg/L and 500 mg/L, as defined by Title 22 California Code of Regulations California Safe Drinking Water Act & Related Laws and Regulations. However, systems that reach the Short Term Secondary MCL Ranges of 1500 mg/L and 600 mg/L must show pending construction of treatment facilities or development of acceptable new water sources.

Rosina Well #1 currently has an average TDS level of 430 mg/L. This well reached TDS levels of 1200 mg/L during the summer of 2016 and chloride levels ranged between 200 and 400 mg/L. Periods of increased production lead to higher levels of TDS and chloride due to an increase in the influence of the local seawater intrusion. In order to reduce the burden on the groundwater basin where seawater intrusion is a problem, Rosina Well is rarely used now that the ion exchange unit is in place for Skyline Well and Rosina is no longer needed to blend down Skyline's nitrates.

The 2015 Basin Management Plan for the Los Osos Groundwater Basin addressed the ongoing issue of seawater intrusion into the basin. Seawater intrusion in the basin has been caused by over pumping of lower aquifer wells on the west side of the basin. To mitigate this, the basin plan calls for the abandonment of westerly lower aquifer wells, and for future wells to be drilled either in the upper aquifer or on the east side of the basin. Within the next one to five years a new well that meets the above requirements should be drilled. A replacement well drilled in the upper aquifer would likely be high in nitrate and necessitate additional nitrate treatment capacity in the system. This could be achieved through upgrading the IX unit that is already in place on the Rosina Treatment Plant site.

7.4.3 Per- and Polyfluoroalkyl Substances

Per- and polyfluoroalkyl substances (PFAS) are a varied and sundry group of compounds used in a variety of industrial and commercial applications including fire-fighting foams, clothing, metal plating, and upholstery.

As a small public water system, the Los Osos System's wells were not required to be monitored for PFAS including PFOA and PFOS as a part of the third unregulated contaminant monitoring rule (UCMR3).

The following outlines regulatory requirements for PFAS:

- In 2015, the EPA released a health advisory for two PFAS compounds, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), at a combined total of 70 nanograms per liter (ng/L).
- In July 2018, DDW set a notification level for PFOS of 13 ng/L and PFOA of 14 ng/L with a recommendation for source treatment or removal from service at a combined 70 ng/L. In the absence of a federal MCL, several states are in the process of developing MCL for PFAS.

- In March 2019, DDW issued the first phase of mandatory PFAS testing orders for public water systems across California based on proximity to: airports with fire training/response sites and previous PFOA/PFOS detections. The Los Osos water system did not receive a mandatory testing order in the first phase.
- In August 2019, DDW revised the notification levels from 13 ng/L to 6.5 ng/L for PFOS and from 14 ng/L to 5.1 ng/L to PFOA.

The regulatory requirements for PFAS are expected to develop over the next one to three years. Regulations for this emerging contaminant will be closely monitored by Golden State Water.

7.5 Recommended Improvements

The water quality concerns that were discussed in the previous sections are summarized in TABLE 7-1.

TABLE 7-1 Recommended Improvements to Address Water Quality Concerns

Alternative Number	Alternative Description
1.5.0	**Monitor Chlorine Residual at Wells**
1.5.1	Install chlorine residual monitors at all wells that do not currently have them and tie into the SCADA system
1.6.0	**Nitrate**
1.6.1	Increase nitrate treatment capacity of Rosina IX Unit (need dependent on replacement well being drilled in upper aquifer)
1.7.0	**Replacement Well**
1.7.1	Replace well(s) lost to seawater intrusion

SECTION 8

System Condition Assessment

The purpose of this section is to provide documentation of GSWC's system condition assessment effort for the Los Osos System. This section is organized as follows:

- Previous system condition assessment efforts
- Updated condition assessments

8.1 Previous System Condition Assessment Efforts

More than 10 years ago, GSWC conducted several facility condition assessment efforts, working with multiple engineering consulting companies to develop a complete condition assessment for each of the Company's systems. Facilities in the Los Osos System were addressed in this effort.

Generally, the purpose of these studies was to inspect and evaluate existing facilities to determine if upgrades would produce significant benefit to offset expenditures. These studies included the following information:

- Evaluations of the safety of the facilities
- Outstanding code violations
- A general evaluation of condition and reliability

8.2 Updated Condition Assessments

For this Master Plan, GSWC Operations and Planning personnel reviewed the condition of plant facilities and pipeline data within the Los Osos System in order to identify the facilities requiring upgrade or replacement. For the pipeline conditional assessments, no specific recommendations were made based solely on condition, but age and material were considered along with pipeline leaks/breaks and input from operations staff.

8.2.1 Facility Condition Review

The purpose of this review was to identify plant improvement projects based on the following:

- Operational needs and requests
- Common items that are not installed at all plant sites
- Recommendations from the previous condition assessments that were not installed

GSWC reviewed each of the following elements to identify potential recommended improvements at each facility:

- Electrical
- Mechanical
- Structural
- Other site improvements

TABLE 8-1 summarizes the recommendations that were developed as a result of the system condition assessment review.

TABLE 8-1 2016 Condition Assessment Plant Projects

Alternative Number	Facility	Project Description	Reason	Priority Category
1.8.0	South Bay Plant	Rehab well	Major rehab will extend useful life of well for 10+ years	Short-term
1.9.0	Cabrillo Plant	Demo and remove tank and Fe/Mn filter, add secondary feed to booster station	In need of extensive repair and media replacement; can be taken off-line after Alamo Reservoir upgrade complete (see note on Table 2-6)	Short-term

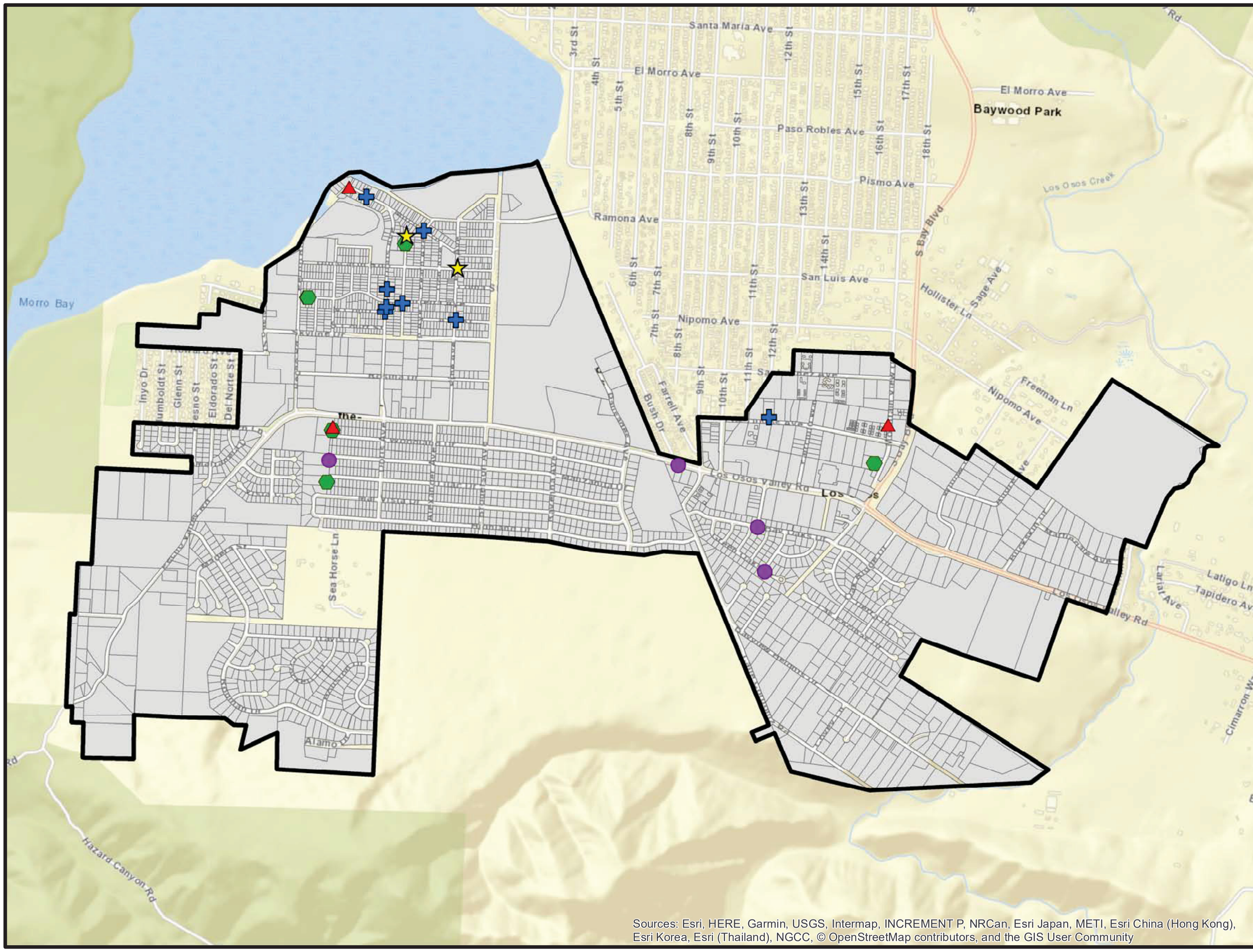
8.2.2 Pipeline Condition Review

In addition to facility condition, GSWC monitors distribution system condition through the tracking of pipeline leaks/breaks on an annual basis; FIGURE 8-1 is a map of the leaks in the Los Osos System from 2014 to 2018. This information was used, along with additional risk assessment analysis, to make recommendations regarding potential CIP projects and in the prioritization of those projects. (See GSWC's *Pipeline Management Program Report* and *Risk Based Asset Management Program Report*.)

TABLE 8-2 2016 Condition Assessment Pipeline Projects

Alternative Number	Recommended Improvement	Reason	Priority Category
1.10.0	Travis Drive w/o Crockett Circle, Replace check valve with dual-flow PRV	Increase supply reliability to Middle Rodman Zone	Short-term
1.11.0	Highland Dr to Los Arboles Way, Approximately 800 LF of 8-inch PVC	Eliminates dead-end and provides redundancy to LOVR main	Short-term
1.12.0	Doris Ave, Approximately 600 LF of 8-inch PVC	Connect mains on Woodland and Lilac; improve fire flows in immediate area and provide parallel main to cross-country main on Clelland slated to be abandoned	Short-term
1.13.0	Santa Ynez Ave Main Extension, Approximately 300 LF of 8-inch PVC	Bring services to ROW and eliminate main through easement in old well site	Short-term
2.1.0	Abandon cross-country main w/o Sunset Ave and install new services	Eliminate dead-end with difficult access	Long-term

Figures



LOS OSOS SYSTEM LEAK MAP 2014 - 2018

Year & Number of Leaks

- *2014 - 8 Leaks*
- *2015 - 4 Leaks*
- *2016 - 6 Leaks*
- *2017 - 3 Leaks*
- *2018 - 2 Leaks*

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Last Update: 1/9/2019

SECTION 9

Capital Improvement Program

The capital improvement program (CIP) is an essential component of this water master plan. The CIP summarizes recommended facilities and establishes the priority and timing of necessary improvements. The recommended improvements were analyzed and evaluated in the previous sections of this report.

The recommended improvements were prioritized into two categories—short-term (existing system) or long-term (2040 system)—to identify when these improvements are required. The project selection and prioritization process considered various issues, including existing deficiencies, projected demands, water quality, regulatory compliance, reliability and facility condition.

9.1 Cost Estimation

No cost estimates are included in this master plan, as the final costs of a project, and the project's resulting feasibility, will depend on actual labor and material costs, inflation, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. Prior to design and construction of any recommended project in this master plan, a detailed project cost estimate will be created.

9.2 Project Prioritization

The following descriptions define how projects were prioritized into one of the two categories:

- **Short-term improvement projects** were based on deficiencies identified in the existing system. Deficiencies included supply and storage, hydraulic, condition assessment, and water quality. Operational improvements were included as a short-term improvement only when a significant short-term benefit was identified.
- **Long-term improvement projects** are based on deficiencies identified beyond the short-term planning years through the year 2040. The water system was assumed to be built out by the year 2040. The long-term improvements are typically projects necessary to meet future demands and replace or rehabilitate aging infrastructure.

9.3 CIP Projects

TABLE 9-1 lists the recommended improvements for the Los Osos System. Each project is assigned a unique identification number and a priority: short-term or long-term. Short-term pipeline projects are shown on FIGURE 9-1.

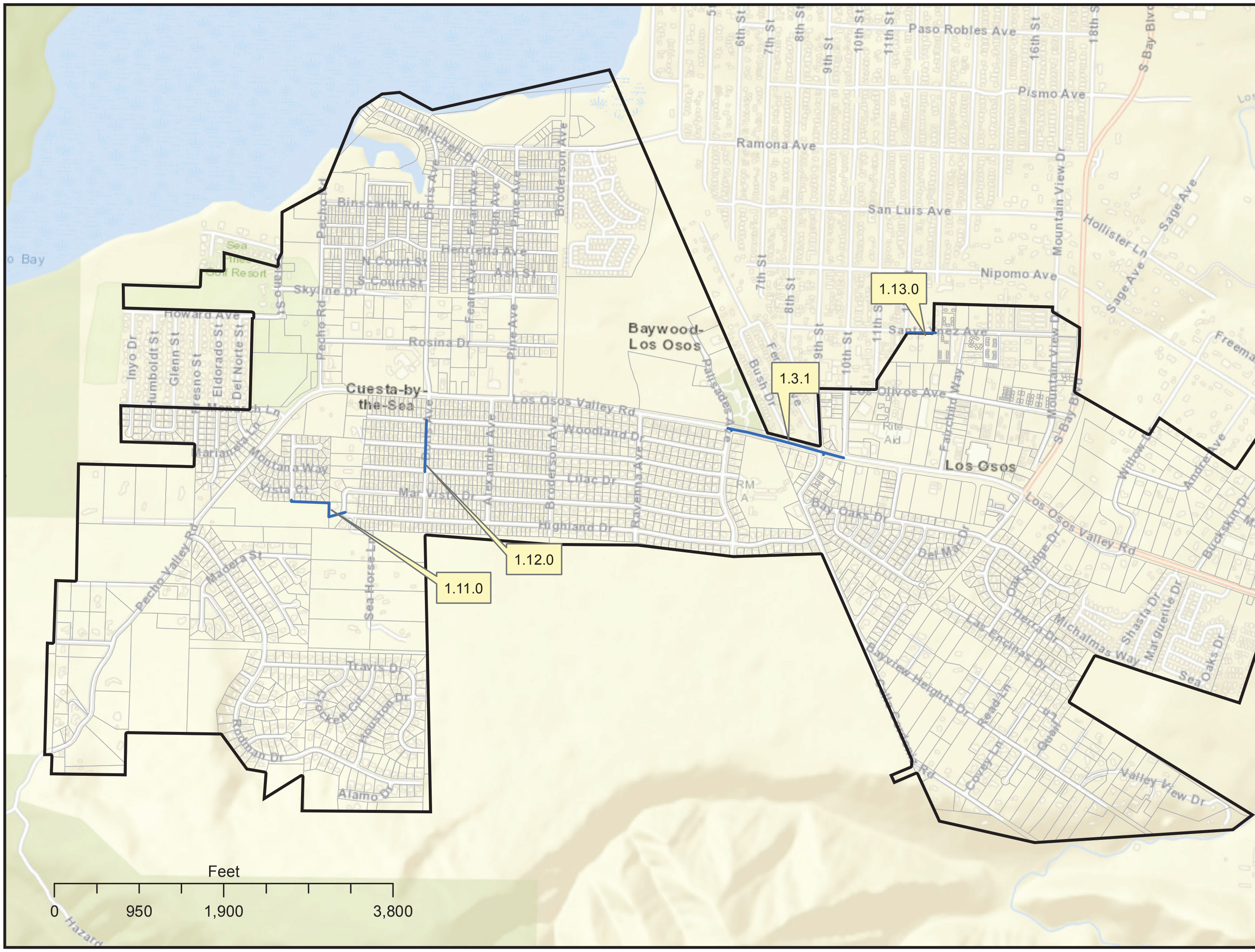
TABLE 9-1 Summary of Recommend CIP Projects

Project ID	Recommended Improvement	Improvement Type	Priority Category
1.3.1	Upsize pipeline on Los Osos Valley Rd between Palisades Dr and Tenth St	Hydraulic	Short-term
1.5.1	Install chlorine residual monitors at all wells that do not currently have them and tie into the SCADA system	Water Quality	Short-term
1.6.1	Increase nitrate treatment capacity of Rosina IX Unit	Water Quality	Short-term
1.7.1	Replace well(s) lost to seawater intrusion and mechanical failure	Water Quality/Supply	Short-term
1.8.0	South Bay Plant Well improvements	Conditional Assessment	Short-term
1.9.0	Demo and remove Cabrillo Plant tank and Fe/Mn filter, add secondary feed to booster station	Conditional Assessment	Short-term
1.10.0	Travis Drive w/o Crockett Circle, Replace check valve with dual-flow PRV	Conditional Assessment	Short-term
1.11.0	Highland Dr to Los Arboles Way Main Installation	Conditional Assessment	Short-term
1.12.0	Doris Ave Main Installation	Conditional Assessment	Short-term
1.13.0	Santa Ynez Ave Main Extension	Conditional Assessment	Short-term
2.1.0	Abandon cross-country main w/o Sunset Ave and install new services	Conditional Assessment	Long-term

9.4 Additional Considerations

N/A

Figures



* X.XX.X is Project ID in reference to Table 9-1 of the Master Plan

FIGURE 9-1
PROPOSED PIPE REPLACEMENT PROJECTS
GSWC REGION I WATER MASTER PLAN
LOS OSOS SYSTEM

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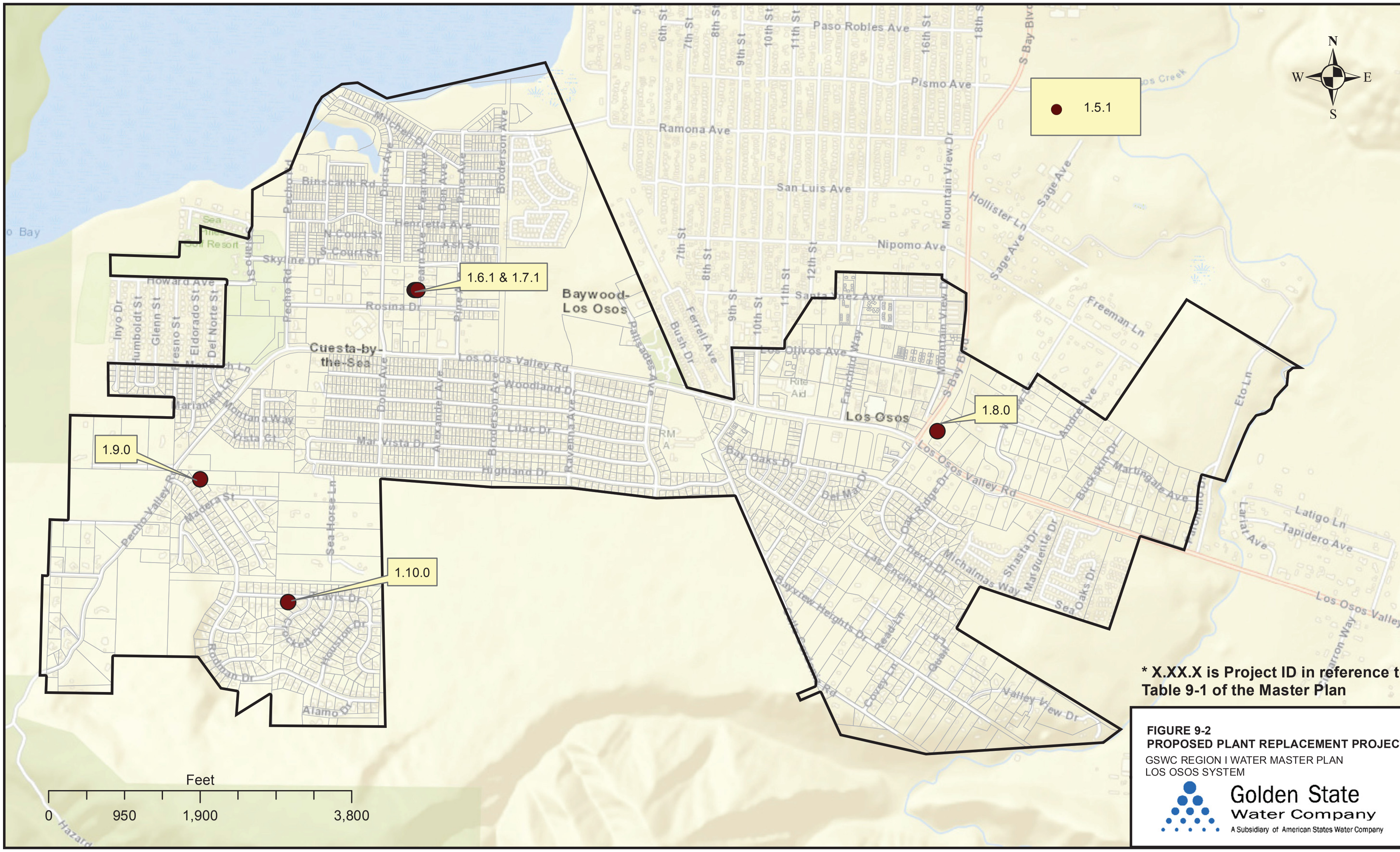

FIGURE 9-2
PROPOSED PLANT REPLACEMENT PROJECTS
GSWC REGION I WATER MASTER PLAN
LOS OSOS SYSTEM

Golden State Water Company
A Subsidiary of American States Water Company

Last Update: 12/18/2019

SECTION 10

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